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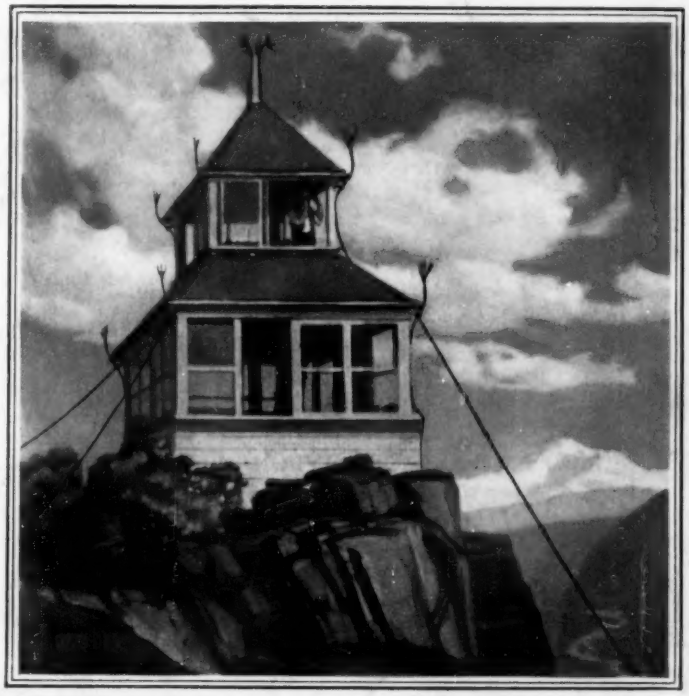
SCIENTIFIC AMERICAN

JUNE 1928 *Thirty-five Cents a Copy*

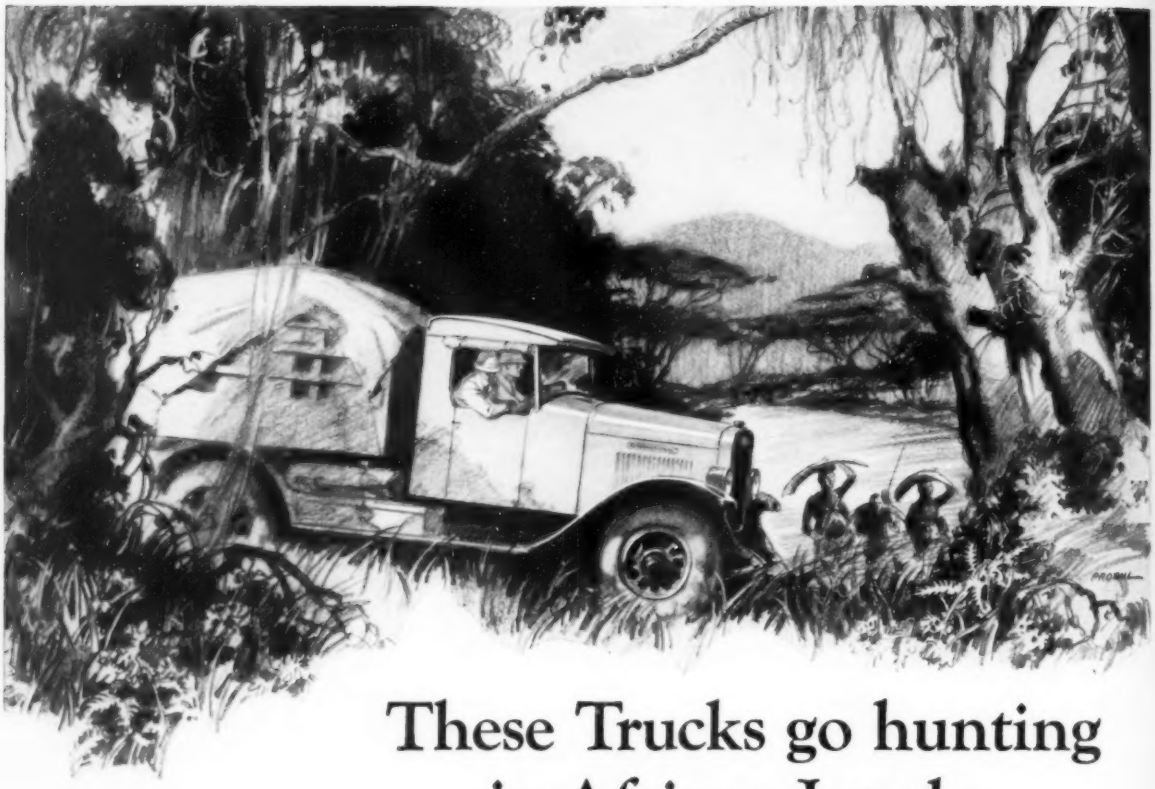


BEARDED INDIANS

By A. HYATT VERRILL

MEN, ATOMS AND STARS

WHY ST. FRANCIS DAM COLLAPSED



These Trucks go hunting in African Jungles

and the hunter calls for more Internationals

Mr. Boshoff, of Westwood, Calif., with some of his trophies

Gentlemen:

Kindly quote me the price on a 1-ton and 1½-ton International Truck chassis to be delivered to Wamaasa, British East Africa, for use around Arusha, Tanganyika Territory.

I have just returned from a hunting expedition in Central Africa. We had two International Special Delivery Trucks which I bought last year from your agent at Nairobi. These gave us excellent service and satisfaction and although we made 9000 miles through dense forest and over mountains, without the vestige of roads, they never left us in the lurch.

I am enclosing a few snapshots taken close to Lake Tanganyika giving you an idea of what we had to go through.

Yours truly,

J. N. BOSHOFF

Loading the trucks for moving camp

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Mr. Boshoff *has been there*, with all the paraphernalia of the African explorer and with International Trucks—"9000 miles through dense forest and over hills and mountains without the vestige of a road." And having braved the fevers, bagged his trophies, and brought his party of Europeans and natives back to port, he is keen to go again—and with International Trucks!

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COVER

This month our artist, Howard V. Brown, has taken for his subject one of the forest lookout houses that have been equipped with lightning protection systems as described in the article beginning on page 489.

The Thrust-Radial Electric Motors

Bearing durability is the critical factor in motor costs. Radical savings are certain with bearings which overcome not only the wear of friction and radial load, *but of thrust and shock as well.* That is exactly what Timken Bearings do, because they have the extreme thrust-radial capacity made possible only by Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken electric steel.

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Timken thrust-radial capacity in motors makes them equally efficient operating on floor, wall or ceiling. It makes them equally wear-proof with any type of drive. It permits the compact mountings that save space, shorten shafts, increase rigidity and improve ventilation.

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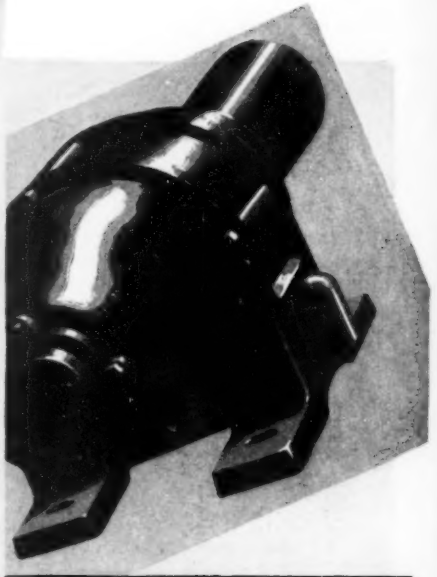

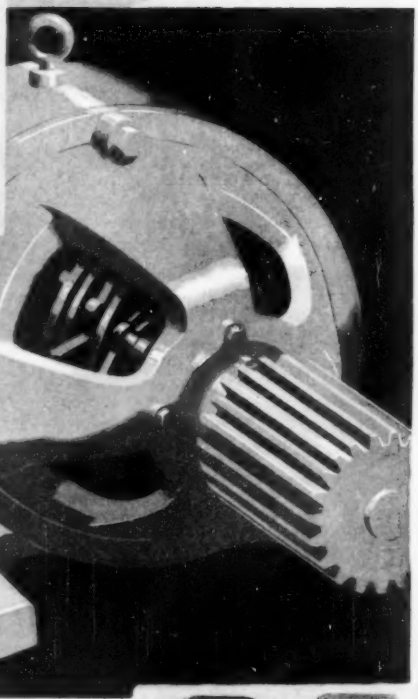

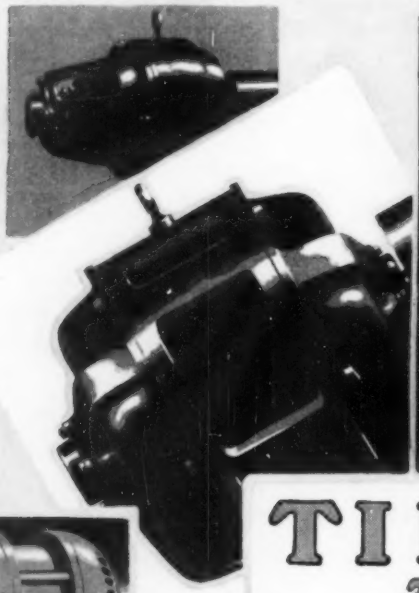

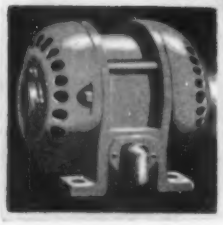

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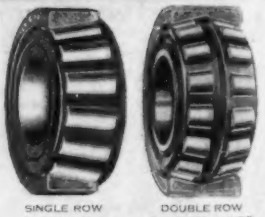
ROLLER BEARINGS



SINGLE ROW TIMKEN BEARING

DOUBLE ROW SELF-CONTAINED TIMKEN BEARING

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International Newsreel

Modern Vikings of the Air

WINGING their way westward through storm and fog the three aviators Koehl, von Huenefeld, and Fitzmaurice, aboard the Junkers airplane *Bremen*, have made the first successful heavier-than-air, east-to-west, transatlantic flight in history. To traverse the ocean in the eastward direction is a remarkable feat, but the crossing from Europe westward is fraught with far greater risk; and this the German-Irish crew of the *Bremen* knew full well when they attempted it. In the temperate zones the weather moves from west to east—rarely from east to west. Steamers make slower passages when heading westward, while airplanes must negotiate about 600 added air miles in the westward crossing of the Atlantic. To storm and snow and fog was added, during the remarkable flight of the *Bremen*, the always unwelcome element of darkness, and thus it is not to be wondered at that the daring little party was unable to complete the full intended journey in one leg, but it is rather to be marveled at that they were able, when fuel ran low, to find a hospitable landing place at all. They did their utmost and successfully crossed the Atlantic Ocean.

The Bearded Indians, An Ethnologic Puzzle

ELSEWHERE in this issue (page 503) the ethnographer, A. Hyatt Verrill, has decribed a little-known but apparently anomalous tribe of savages who inhabit an inaccessible area in Bolivia. According to his hypothesis these people are not American Indians but some of the island stocks from the distant archipelagos of the Pacific, transplanted to South America. Admittedly, a close scrutiny of the photograph reproduced above lends some support to this suspicion. How these or similar island peoples may have reached South America from across the broad Pacific has perhaps been best explained by the anthropologist, Professor G. Elliot Smith, who believes they came in large canoes. Although this "diffusionist" belief is opposed by the majority of anthropologists, it is nevertheless in good scientific standing and may yet become the accepted doctrine.

Courtesy United States Forest Service

A TYPICAL LOOKOUT STATION

Perched precariously on a bald rock near the summit of a high peak in one of our national forests, this box-like, frail house is the residence and watch tower of a lookout who braves the perils of numerous terrific electrical storms

Forest Lookouts Defy Lightning

Stations Struck Frequently and Many Lookouts Killed Before Lightning Protection "Bird Cages" Were Adopted

By IRVING BRANT

FRED SCHNELLING, forest lookout on Mt. Hood, was yawning sleepily when a party of rangers, anxious because of his failure to answer the telephone, met him one morning after a crashing thunderstorm.

"What's the matter, Fred?" asked one of the rangers. "Didn't you sleep well?"

"Pretty well," said Fred. "I woke up several times."

"House was hit by lightning, I suppose?"

"Three times," Schnelling replied.

"What did you do?" inquired a ranger.

"Well," said the lookout, "the first time it got hit, I sat up. Then I just got to sleep when another bolt struck the house, so I sat up again. After a while it got struck for the third time, and I could feel rain coming in, so I got up and saw that part of the roof was torn off."

"What did you do then?"

"I lay down again."

Unfortunately, the laconic response of Fred Schnelling does not cover the case. Stoicism such as his may even have delayed recognition of the fact that the men in forest lookout houses are exposed to greater danger from lightning than is any other class of workers throughout the world today.

On the evening of June 30, 1924, with a heavy storm coming on, Victor Ortego joined his wife and two children in the lookout station on Canjilon Mountain, Carson National Forest, New Mexico. A bolt of lightning entered the house by way of the stove pipe, struck the lookout and burned his leg severely. He sat down on the bed, and Mrs. Ortego dressed the wound. While he sat there, a second bolt of lightning struck the house, killed Ortego, knocked Mrs. Ortego down and killed a dog. Not until the storm ended was she able to take the children and walk several miles for help.

THREE days later, in the Datil National Forest of New Mexico, the Mangas Mountain lookout station was struck by lightning. Of its two occupants, the "smoke chaser," recovered consciousness in 20 minutes to find the lookout, Willis Ditmore, dead beside him.

Paul Blickensderfer, lookout man at South Baldy Mountain, Kaniksu National Forest, Washington, received a visit from district forestry officers on the evening of July 11, 1925. He gave up his bed to one of them and slept on the floor. At 4:30 in the

Courtesy United States Forest Service

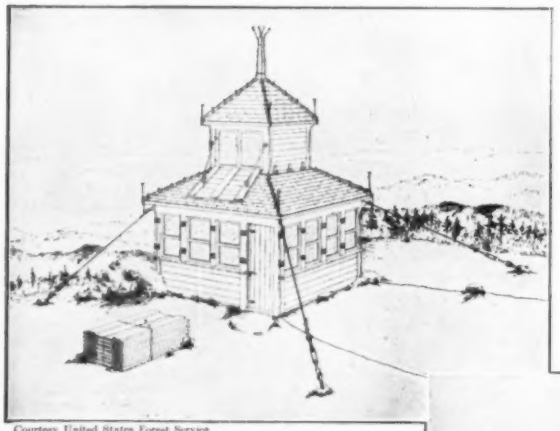
ON THE ALERT

The lone lookout in his tower watching for indication of fires in distant forested hills

morning, Murray, one of the four men in the cabin, was awakened by a thunderstorm. He saw a bolt of lightning come down the stove pipe and spread out over the floor where Blickensderfer and Blake were sleeping. Blickensderfer was killed and the other three men were badly shocked.

Frank C. Armer, lookout on McFadden Peak in the Tonto National Forest of Arizona, is a cripple for life as the result of being struck by lightning on July 30, 1925.

This is a partial list of the casualties which occurred in two years among the handful of men living in the lookout stations of the national forest areas. In addition, there is scarcely a lookout house in the far west that has not been struck, and many of them struck again and again, with heavy property damage. The old superstition that lightning never strikes twice in the same place is well refuted by the lookout houses, although, as far as that cherished belief is concerned, the Forest Service has records of individual trees which have been struck seven or eight times, and one record shows that out of 907 cases of lightning strokes on trees and buildings, 21 were repetitions.



Courtesy United States Forest Service

LOOKOUT STATION DESIGN

Drawing of ready-cut house showing installation of guy wires and "bird cage"

THE peculiar hazard of Forest Service lookout houses is not due to prevalence of thunderstorms in the national forest areas. There is more lightning in Florida and Illinois than anywhere else in the United States, with little damage from it, and in general the region east of the Rocky Mountains has four or five times as much lightning as the region west of them, whereas the lookout stations are mostly in the west. The hazard is due to excessive exposure to lightning.

Lookout houses are struck by lightning for the same reason that the tallest tree is struck, or the isolated farmhouse, or the jutting rock on a hilltop, or the lone man in a field. The forest fire lookout station by necessity is located on the topmost peak of a bare mountain, overlooking the surrounding forests. In addition, the lookout houses are often located in or near what is known as a lightning zone, an area where lightning is most likely to strike the earth.

A lightning zone is a thundercloud stratum of the lower atmosphere touching the tops of moderately high mountains and lying against the sides of the high peaks. The hazard is greatest where this area of discharge comes close to the earth, for the lightning is discharged between areas differently electrified, and there is sometimes a difference in potential amounting to thousands of volts between the earth and a point 10 feet above it. The actual potential is higher at a greater distance above the earth's surface, but the difference in potential per unit of vertical distance decreases with altitude, and it is difference in potential which produces the flash.

These two factors—projection above the surrounding country, and nearness to the zone of electrical activity—make the lookout house an ideal mark for the lightning bolt.

The long and distressing series of casualties, and the constant property damage, has stirred the United States Forest Service to experiment with lightning protection devices, and a protective system has finally been worked out which is proving its worth so thoroughly that it is to be extended to all lookout houses in the United States. It is expected to end the death list and stop the destruction of property.

This is the so-called "bird cage," a skeleton of steel cable encompassing the lookout house, and grounded as well as possible in a region where grounding is ordinarily difficult.

The lookout station is a building 12 feet square, surmounted by a tower six feet square. It is shaped like a bird cage, and the resemblance is naturally stronger when the cable cage is built about it.

FROM a post on top of the tower, four half-inch galvanized stranded cables run diagonally to the four corners of the tower roof, down to the main roof and to each corner of the house, then down the four corners of the house from roof to ground, and thence into a grounding place not more than 300 feet distant.

In addition, the building is completely encircled by four horizontal wire cables; one at the eaves of the tower, one at the base of the tower, a third at the eaves of the house, and a fourth along the ground. These are connected with the vertical cables, all together forming the conductor system.

The four vertical cables project six inches above the top of the tower post. Their ends, bent slightly apart, are frayed to present many collecting points for the electrical charge. Similar projections frayed in the same manner, project upwards from each corner of the tower roof and from each corner of the main roof. Thus there are the main center receiving points of four cables and eight other projections at the most exposed points on the building. The projections, the vertical cables, and the horizontal cables are clamped together at each corner with three-eighths inch pipe straps, and are also clamped to the guy wires which protect the lookout houses against wind. The guy wires furnish additional metal for absorption of heat generated by the lightning.

Courtesy United States Forest Service

GOAT PEAK LOOKOUT

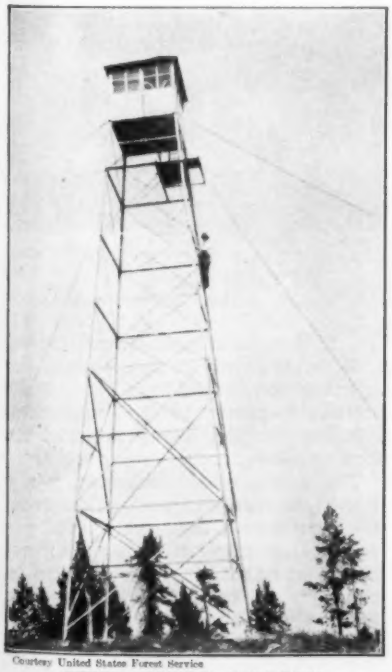
Here a ranger is shown installing the lightning rods along the eaves of a lookout station to eliminate future storm danger

Wherever a cable runs over the roof, as it does along the hip shingles, it is fastened to every other metal shingle by a wire riveted and soldered to the shingle and twisted about the cable. The points of the wire are left sticking up in the air as additional invitations to the electrical charge.

The conductor cables, under ideal conditions, would be grounded in moist earth, but most lookout stations are located on barren mountains, with no natural grounding place within half a mile. To remedy this defect, an artificial ground is prepared 125 feet from each corner of the building. A pit is dug, or blasted, and 30 or 40 feet of the wire cable is rolled up, placed in the pit and covered with fine charcoal or coke, two sacks to each cable. This charcoal is saturated with water from time to time, and retains moisture for a long period.

IN most locations, the cage as described above is considered adequate without insulation. But where the lightning hazard is unusually great, the conductors are insulated or, if conditions permit, are separated from the building by from 10 to 15 feet of air space.

In all cases, lookouts are advised to take additional precautions. The telephone is located as far as possible from any conductor, and during a storm the telephone wire is to be disconnected and removed to a distance of 15 or 20 feet from the building. Furniture should be non-metallic, and in general there should be as little metal inside the house as possible, and as much of it as possible outside.



Courtesy United States Forest Service

STEEL TOWER STATION

This tower, 80 feet high, stands on Desolation Butte. Whitman National Forest

The Forest Service recommends that kerosene stoves be used for cooking in lookout houses, because the lightning hazard is greatly increased by the smoke and hot air from a wood stove chimney. But if a stove is used, a galvanized roof jack is employed, and is bonded securely to the nearest conductor cable with not less than four strands of Number 9 iron wire, twisted.

In erecting a "bird cage," the most important thing is to make sure by proper location of the cables and their points that any lightning stroke will encounter the metal of the cage rather than the framework of the building or any metal in it. Next, and equally important, is the use of a sufficient quantity of metal in the cage to absorb and dissipate the heat of the lightning without overheating the cables.

C. M. Allen, telephone engineer of the North Pacific District of the Forest Service, Portland, Oregon, who worked out the details of the "bird cage," says:

"The extremely high frequency of a lightning discharge increases the normal resistance per foot of the conductors many thousand times. We have worked on the theory that the energy in a lightning discharge is dissipated in heat radiation. Therefore our network of conductors and counterpoise (or ground) must contain a maximum amount of metal surface over which the lightning may spread without developing excessive heat."

It is this increase in the resistance of the conductors which makes it impossible to run long ground wires to naturally moist ground. Long ground wires would burn up before they could dissipate the load.

Mr. Allen and other observers believe that to some extent there is a continuous discharge through the protective cables during electrical storms, and that this discharge, mostly through the points of cable on the building, tends to prevent, or at least to diminish, the intensity of a direct stroke.

Courtesy United States Forest Service

MOUNT HOOD STATION SNOWED UNDER

This station, only the cupola of which shows above the snow, has been struck repeatedly by lightning—on one occasion, three times in half an hour. Photograph taken in July

The Mt. McLaughlin lookout station is protected by a "bird cage" which sometimes becomes virtually red hot during a thunderstorm. This lookout house is located over basaltic lava. Presumably because of magnetite in the lava, or because of the columnar and jagged formation of the basalt, or both, there appears to be a notable continuous discharge; and this may be an extreme illustration of a general phenomenon. If so, it verifies the original observation which led to the protection of lookout houses.

THIRTEEN years ago C. H. Flory, a western forestry officer, saw a water pipe beside a lookout house become red hot during an electrical storm. A slight explosion followed and it cooled off. When the problem of lightning protection came up in consequence of the growing death list in the Forest Service, E. H. McDaniels of the Portland office remembered what Mr. Flory had said, years earlier, and it suggested to him that lookout houses could be protected by inducing a continuous discharge.

The lookout man in the mountains, protected by his network of cables, is apparently as safe today as his neighbor who lives in the city or on the farm where the natural hazards

are but a fraction as great. In the last two years several lookout houses with "bird cage" protection have been struck by lightning, but no damage to the buildings or injury to occupants has been reported. In one case, the Crow Point lookout, in Fremont National Forest, was stunned for four hours, but recovered.

Individual lookouts, where they have the training, are ideally located for experimental work. Experiments in continuous discharge have been conducted for a number of years by J. F. G. Coné, a Forest Service lookout whose station is located on the exact top of snow-covered Mt. Pitt, Oregon, 9500 feet above sea level.

"I obtain continuous discharges with every storm which passes over my peak," Mr. Coné said. "Taking

ABOVE THE TIMBER LINE

The lookout in the station that is situated on the top of this peak of Mt. Pitt, Oregon—9500 feet elevation—has a commanding view of the surrounding country for many miles

Dr. Steinmetz's rule of 25.5 kilovolts for each centimeter of air between points one centimeter in diameter, I have obtained a voltage of 197 kilovolts for a period of 42 minutes."

From his experiments, Mr. Coné deduces that the area of potential is a unit, rotating about its own center, and does not extend to the outer limits of the cloud mass, while there may be one or more units of localization in each cloud mass.

ALTHOUGH he does not regard his deductions as proved, he does not believe there is ever a discharge from earth to cloud. This conflicts with the belief, cited, although not asserted, by Fred G. Plummer in his monograph on "Lightning in Relation to Forest Fires," (1912), that lightning flashes sometimes ascend from the earth into the air. As such ascending flashes are credited with great explosive power, the absence of any tendency toward an earth to cloud discharge in the vicinity of the Mt. Pitt protective cage is of considerable interest.

The work which the Government has undertaken has had reference only to the peculiar hazards of the forest lookout, but the results are available to the general public. The lookout houses are only 12 feet square and it requires 46 dollars and 25 cents worth of materials to protect them. An ordinary dwelling would require far more material if protected with equal intensiveness, although in most cases it would be easier to make ground connections.

Where an electrical discharge can be dissipated quickly into a natural ground, less metal is required for protective purposes. The Government recommends, for a ground, that a copper plate, three feet square and a sixteenth of an inch thick, attached to the grounding cable, be buried in permanently moist soil. But a ball of wire is almost as good. The ground wire should be short, provided it reaches a good terminus, and should be buried 10 feet under ground if there is soil, or weighted down with rocks.

It is of the utmost importance that the ground connection be permanently moist. Th. du Moncel determined years ago that, whereas various kinds of wood as received from the carpenter would conduct current to deflect a galvanometer needle from 32 to 87 degrees, the same wood, after two hours in the oven, was a non-conductor. The United States Forest Service has determined that there is very little difference in the conductivity of various kinds of trees during a storm, because the poorest conductor (a resinous tree with low moisture content) will have high conductivity the instant it is wet with rain.

The same principle applies to a ground connection. No matter how well constructed, it is a poor ground unless the soil is wet.

The damage which results when there is not enough properly arranged metal to dissipate a lightning bolt, or when a ground connection is lacking, was illustrated when lightning struck the Mt. McGregor lookout house in Chelan National Forest. The house was then under construction and the protective cage had not been built. Lightning struck the tower, ran down the metal hip shingles and down a guy wire, exploded a 600 pound boulder to which the wire was anchored, and jumped to the drag line of a 1400-foot tramway which was being used for hauling materials up the mountain. It cut the drag line off at each place where it ran through a block. This allowed a carriage to run to the bottom of the tramway and be demolished. The lightning jumped from the drag cable to a telephone line, kinking it every six inches for an eighth of a mile. The bolt, via the telephone wire, entered a Forest Service camp half a mile from the lookout house. Mr. Ramm, the carpenter, was knocked unconscious for 20 minutes and received a burn the size of a dollar on top of his head and many small burns on the bottom of his feet. Mr. Heaton, the lookout, wore rubber shoes and was uninjured.

THIS superheating, burning, and jumping of the bolt presents the condition which Mr. Allen, designer of the "bird cage," overcomes through the liberal use of metal and the quadruple counterpoise. The 1400 feet of wire cable destroyed by lightning in the Mt. McLaughlin accident, if divided and grounded so as to dissipate the lightning bolt, would have been nearly sufficient to protect two lookout houses, 770 feet of cable being required for each house.

Courtesy United States Forest Service

FULLY PROTECTED

Standard lookout house on Mt. Emily, Oregon, equipped with "bird cage" protection

The problem of safeguarding the lives of the men who work in loneliness on the mountain tops appears to have been solved. And that is a step, not an unimportant one, in solving the primary problem of lightning as a direct agent in causing forest fires. Out of all the fires which occurred in 1926 in the national forests, 3387, or 47.74 percent of the total, were caused by lightning.

Men, Atoms, *and* Stars

Man Has Existed but a Day; Observed the Universe but a Minute —Is it any Wonder He Still Has Much to Learn?

By M. LUCKIESH

Director, Lighting Research Laboratory National Lamp Works of General Electric Company, Nela Park, Cleveland, Ohio

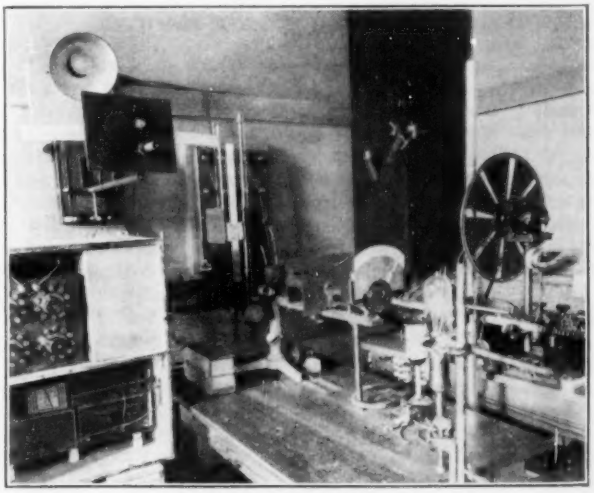
OUR immediate world—that which is quite real to us and comprehensible—lies between two awesome extremes. On the one hand is the great stellar universe of almost meaningless distances—and, still, perhaps it is only one of many in an endless void. On the other hand, are the minute worlds, the atoms, and, one might say, universes of them represented in different material bodies. These dimensions are so small that they are scarcely comprehensible to us. Our own every-day world is large—if it is all that we know or think of.

What slaves we are to dimensions! Viewing our restricted world of communication and transportation alone, its distances are great. But when our imagination soars on the wings of knowledge, expanding to those great highways of stars, the world of men shrinks into insignificance. Or when we compress our mental outlook into the delicate mechanism of atoms we become incomprehensible giants—though still insignificant. With this feeling comes the question of our importance in the scheme of things. But whether important or not, we are curious and ambitious enough to explore the great all-inclusive world of atoms and stars.

SUCH a glimpse shows us that dimensions are merely relative; that what is large or what is small is made so by us, by comparison with that which is commonplace to us. In fact, the prejudices of our experiences, the limitations and multiplicity of our senses, introduce much apparent complexity into the physical world. We see light, hear sound, feel temperature, and experience weight or force. The senses involved divide physical phenomena into such arbitrary branches as optics, acoustics, heat, and mechanics. We have no special sense-organ for electricity, and for this reason science has traversed a devious pathway before arriving at the threshold of what now appears to be a conclusion that electricity, or something akin to it, is the primordial stuff of which all matter is composed. There are 92 elements, total strangers to each other if judged by their properties and appearances. Our senses could not suspect directly that they are all made of the same material—but apparently they are.

When we see light we see merely surfaces that are more or less bright and colored. We gain no glimpse of the light-waves or of the actual mechanism of the energy which produces the sensation in us. We do not even have the feeling that this light is flowing from the object to us—but it is.

LIKEWISE when we hear sounds we do not gain a conception of the mechanical waves which produce the sensation through the doorway of the ear. When we feel a warm object our sense does not tell us that the molecules of the object are vibrating; still, that is why the object feels warm. And so it is with most of the foundations of the physical world. We must be ingenious enough to obtain a picture of the mechanisms by indirect means, for our senses are very limited and misleading.



A MESSAGE DECODER

With the spectroscope man has learned to read the "message" of the Universe. Physically man is a mote, but his mind is mighty

The egotism of Man has made many mistakes in studying the external world about him; still it redeems itself because it is also responsible for Man's studying. Finding himself in a universe of which he knew nothing, it is natural that he appeared to himself as the center of the universe. His own importance overwhelmed everything and he naturally thought that everything was created for him. As knowledge grows it becomes increasingly difficult to maintain that attitude. When we view the all-inclusive world we become extremely insignificant. Are we any more important in the great scheme of things than a blade of grass or a particle of star-dust? Does the destiny of these differ from ours?

Reincarnation of the soul has been dreamed of and desired by many peoples. Faith in an everlasting life has nourished the hopes of countless persons for ages. After all these years we are still uncertain of the destiny of that intangible part of us—the soul or mind entity. Can we suppress a smile when we admit that knowledge has proved reincarnation and practically eternal life for dead matter but has revealed as yet no such proof for our so-called souls? We lie down at night and our minds rest in unconsciousness. The atoms in the textiles which cover us are as vibrant with life as those in our bodies. The electrons in the atoms continue revolving in their orbits and the molecules composed of atoms continue vibrating. These movements of these small elemental bodies go on whether we waken or die and they go on doing this forever, barring some cataclysmic phenomenon which only exists in theory as yet. The irony of it! Knowledge has first proved the eternal life of matter.

A SO-CALLED living thing dies; but its myriad atoms are as alive as ever. The particular organization of atoms represented by that dead body is mustered out. Molecules break up and most of the atoms of which they were composed join other groups of atoms recruited from far and wide. Some atoms in certain compounds "to dust returneth," to lie for eons with their constituent electrons eternally in motion. Others may become parts of short-lived leaves and blades of grass, co-operating with myriad others for a single summer, before passing into another phase of their eternal life. Some may escape into the atmosphere to

bound here and there until used again in one of Nature's works. Still others may be anchored for longer time in the trunks of trees.

We can imagine many interesting migrations of matter during the course of which many reincarnations take place. For example, an atom of oxygen which we now breathe may have come to our Earth from afar in a meteor. Perhaps it was formed billions of years ago under the extreme conditions of pressure and temperature only found in a stellar crucible—a far-off nebula. The nebula cooled and contracted or the passing of a celestial body near it may have torn a piece away. The oxygen atom was a part of a meteor which traveled erratically for eons. This piece of "driftwood" of space eventually entered the Earth's atmosphere and burned with a brilliant trailing flash in the fires of friction. The oxygen atom came to the Earth in the ash-dust.

THIS may have been millions of years ago. The electrons rotated in the orbits of this atom all this time. The atom became a part of a molecule of mineral salt. Eventually it passed upward into a plant and became a part of living matter. The plant bloomed, died, and decayed. The atom may have become a part of a bacterium and eventually of an animal higher in the scale. It may have "returned to dust" many times before it became associated with another atom of oxygen and one of hydrogen. Now it is a part of a molecule of water. Again it has a devious journey and many reincarnations. Finally, freed of other elements, it bounded here and there in the air. How many human beings may have inhaled it and used it and exhaled it before it now enters our lungs? This is the merest glimpse of its eternal life—unchanged although reincarnated countless times.

With the most powerful microscope the smallest object we can see is about 1000 times larger than a hydrogen molecule which consists of two atoms. Much of our knowledge of the structure of atoms is derived from the light-signals, the electro-magnetic waves, which they emit. These are the original and eternal broadcasting-stations. The electrons in an atom revolve at various speeds, making millions of revolutions in a very small fraction of a second. It is thought that they emit an entity—quantum—of energy when they jump from one orbit to another. At any rate they do send out these light-signals consisting of energy of various definite wavelengths. Atoms of different elements emit different light-signals; however, under the same conditions all atoms of a given element always emit the identical light-signals.

As we sit nightly listening to radio stations in all parts of the country, most of us do not cease to marvel at this new scientific achievement. To many persons it is even awesome, and, perhaps, profoundly mysterious. It is something for Man to be proud of, indeed, and it is the result of his curiosity and egotism. But is it not even more startling to think of the myriad atoms of many elements signaling to us from incomprehensibly distant stars? These messages not only tell that the corresponding elements are there, but they tell those who understand them a great deal about the size, temperature, composition, rotation, velocity, and distance of these stellar broadcasting-stations. We dream of signals from Mars which at its nearest is only 35 million miles away. Ever since stars and nebulae existed and as long as they exist, the atoms of the elements of which these celestial bodies are composed have sent and will continue to send their messages.

FAR OFF, MYSTERIOUS, YET FAMILIAR

Some of the inhabitants of space—stars, dark clouds, gaseous balls and streams. Although distant, they are made of atoms like those we know

MAN depends much upon light in his daily activities. It is essential to vision and most of his usefulness, and his contact with the world about him is due to light. His knowledge of atoms is nearly all due to light and his acquaintance with the universe out of reach is solely acquired through light — that faithful, ever-working messenger.

The atomic broadcasting-stations make it possible for the astro-physicist to make use of stellar crucibles. First, he has learned much in his laboratory about elements and their characteristic signals. He has excited atoms under various conditions of temperature and pressure and has studied their signals. However, man-made laboratories in this respect are puny compared with those of celestial space. With what he has learned he transfers his laboratory, remaining here with his gigantic telescopes. In those far-off stellar laboratories Nature supplies almost incomprehensible temperatures and pressures. In those crucibles he witnesses alchemy or chemical wizardry. There is evidence that in them, protons and electrons are being put together to form the elements. Thus he begins to believe that energy and matter are interchangeable and that matter is made from energy under the extreme conditions in the nebulae or stars. Some of the pressures are so great that the outer rings of the atoms are absent or greatly compressed. It is known that the very small nucleus of an atom is responsible for most of its mass. Therefore, some astro-physicists believe that the density of some of the gaseous or molten stars is hundreds and perhaps thousands of times greater than the heaviest element on Earth.

IT is possible that we have glimpsed the manner in which the 92 elements have been made from primordial energy. From experiments with uranium, the heaviest element, it is seen to break down spontaneously to form several elements, one being radium, and the final one, lead. Possibly this disintegration is slowly going on and elements are made from the one parent element. Possibly the packing process in the stellar crucibles is not always carried to the extreme. Here is the point where knowledge of this subject ends at present. We have the 92 elements made of the same "stuff." Somehow they were made. Some, if not all of them, disintegrate to form other elements.

We have had a glimpse of the tiny atoms in which orderly activity is going on eternally. Now let us look at the stars. To most persons a glimpse of the night sky reveals what appear to be countless heavenly bodies scattered in confusion. To count these specks of light seems an awesome and even an impossible task. Still, on a clear moonless night we can see with the naked eye only a few thousand stars. All persons over the entire face of the Earth can see less than ten thousand. We may easily pick out that bright star, Sirius. It is one of our nearest neighbors, which are really stars, but it is 500,000 times farther away from us than the Sun. It is 54 million million

miles away. It would take the fastest airplane nearly 25 million years to travel such a distance.

Notwithstanding this great distance, the diameter of the universe which we see with unaided eyes is about 100 times greater. But this is not all, for the telescope reveals a universe 100 times greater than that seen by the unaided eyes. A billion stars have been revealed.

NOW in our imagination let us view the universe from the far-off point of vantage, with super-eyes that annihilate distance and with a mind freed from the prejudice of every-day dimensions. We see from this seat of the gods a vast black space in which bright bodies are moving in apparent disorder. They are like bubbles in invisible currents. Many of these millions of celestial bodies glow by their own light. Many of them are not self-luminous, but shine by light borrowed from nearby brilliant gems. These occasionally pass into shadows and become faint ghosts illuminated by distant stars. But there are no great shadows, for everywhere celestial space is velvety black, and upon this dark background we are seeing the gems of the universe from this far-off viewpoint we have assumed.

Looking back at the region where Earth is an insignificant part of the whole, we see our solar system which is also a very minor part. It consists of a few bodies among millions. On close observation we see this planetary system—a number of small planets volving around the Sun, which is a mediocre star. Some of these planets have satellites attending them. Our eyes range over the universe and we see thousands of spiral nebulae twisting themselves into balls—almost infinitely slowly as measured by Man's ideas of time. Some of these nebulae seem to be outside our universe. Are there other universes? It is thought quite likely. Here and there comets dash along in apparent independence. Small bodies which we term meteors are passing along like hailstones compared with the Earth.

THE WORK OF ATOMS

Thorium atoms in a gas mantle broke down, released energy and made this contact print

The millions of bright gems in this dark void vary greatly in size, shape, brightness, velocity, and direction of motion. The first glimpse gives the impression of chaos. Observations of a year or two reveal systematic motion here and there, such as the rotation of bodies and the revolutions of their satellites. A century of observation would include more than one complete journey of some comets over their eccentric pathways. It would reveal orderliness in our solar system and in some other places. A thousand years might show enough to make it safe to predict that all bodies were obeying certain laws, and our impression of chaos changes into one of cosmos. But this period is too short to detect progress in nebulae toward the spherical form which they seem to desire. If in some such manner we can rid ourselves of the prejudices imposed by our experience as earth-beings in *time* as well as in distance, we would then be ready to view the universe as a whole in our imagination.

WE have heard the question, "Where does the light go when it goes out?" Few could answer the question completely. The scientist can do so only if his present theories are correct. We know that it takes time for light to travel between two points. Its velocity is about 186,000 miles per second and according to present theory this is the maximum velocity attainable. We know that it takes light eight minutes to travel from the Sun to us. Therefore, any event we see on the Sun's surface took place eight minutes before we can see it. If we asked a question of somone as far away as Sirius, 18 years would elapse before we could have a reply if we used that speediest of messengers—light.

Still, these are small distances compared with others in the universe. It takes light 75 years to reach us from the North Star. It would shine for 75 years after it was totally destroyed. It takes light 100,000 years to reach us from the star cluster in Hercules.

We say that an electric light is steady. We do not see the flow of light but that source is really a fountain spraying light steadily in all directions. We put out the light but it would seem to burn nine more years for someone as far away as Sirius—if he could see it. Light travels outwards in all directions. That which has started continues to travel regardless of the source. Eventually, that which has not been absorbed by striking bodies returns to the place where the source was—if theory is correct. That is, it returns after millions of years to the spot where the source was when it left.

In other words, energy has mass and

AS MAN CONCEIVES IT

A simple atom as man's imagination pictures it in the light of present knowledge

is influenced by gravitation. This light-energy traveled always under the influence of gravitational attraction and its path was curved like that of a periodic comet. Eventually, the rays which traveled in all directions returned to their place of birth to travel outward again, and so forth. In the course of many complete cycles it becomes absorbed by striking this and that body, but the main point is that energy does not escape from the universe. If that theory is correct the total energy of the universe—potential and kinetic—is constant and is the same now as it was. For the present, we can only wonder.

MANY interesting and even fantastic ideas could be worked out on the foregoing basis, but the theory is not sufficiently established to warrant this. However, a fascinating idea can be based upon possibilities adequately supported by established facts. First, we take advantage of the finite velocity of light. Next, we invent a super-telescope. The practical limit of optical magnification probably cannot be extended much further, but electrical magnification is practicaily unlimited. Let us introduce electrical magnification into the midst of the optical system of a telescope. Let us convert light after it enters the objective end of the telescope into electricity, then after enormous electrical amplification let us convert it back into light. This is actually being done in various practical devices. Thus we have a super-telescope, apparently theoretically possible.

Recent measurements indicate that certain known celestial bodies are millions of light years away. From mirrors upon these we could look back into great geological and zoological ages.

Our Point

THE GREAT SMOKIES

ABOUNDING in historical interest; possessive of varied charms, wild game in plenty, and almost the last remnant of the primeval forests that once covered America; and populated with sturdy and simple folk as yet untarnished by contact with our feverish civilization, a great tract of land, 700 square miles in extent, will shortly be set aside along the mountainous border between Tennessee and North Carolina, to be known as the Great Smoky Mountain National Park. It has been heralded as the future playground of the East.

The creation of this park is a laudable undertaking, but botanists, naturalists, geologists, geographers, and others who have found this a fertile field of research in the past, will be sorry to witness the change that is bound to come over the region. Tin cans and bottles, paper containers and picnickers' waste will mar its charms; purring automobiles will cast a pall of dust over the landscape; unsightly signs will inevitably appear; and picturesque cabin homes will, no doubt, be transformed into "Inns" purveying native "moonshine" and many of the useless things of outside civilization. Experience tells us that careless tourists will also start disastrous forest fires.

We hope that our pessimism will not turn out to be prophetic. If so, we hope legislative action will prohibit, as much as possible, too great a change in this beauty spot. But above all, we hope that tourists will be appreciative enough to preserve things as they find them there. If for no other reason, the region should be saved to supply themes for perennial Broadway dramas and subjects for authors who, periodically, "discover" this land of indigenous Americans.

EXCELSIOR!

THE Department of the Interior estimates 80,000,000,000 kilowatt-hours output of electric power for the United States in 1927. If this power could be converted into its equivalent of man-power, it would provide the average family of about four persons in the United States with the equivalent of the services of eleven able-bodied mechanical laborers working eight hours daily, 365 days of the year! Total cost of this eleven-man-power-year averages only 75 dollars per family!

Could anything more forcibly remind us of the tremendous advantages of our present era? Could anything be more convincing? And yet there are among us many who deprecate the achievements of our civilization; who are afraid that we shall become mechanized to the extent that man will lose his initiative and another Dark Age will be upon us; who are more enamored of tradition than foresighted and forward-looking. Perhaps they are right; perhaps man will sink into oblivion for a long period. But why? Of the many possible answers, one seems greatest: Man, himself. Man is his own worst enemy! If he fails to follow the ambitious pace of the age, he will most certainly go into the discard. The mass of the pessimists will surely act as the millstone around the neck of progress.

Man, himself, will be to blame—not the machine, for, as General John J. Carty, vice-president of the American Telephone and Telegraph Company, says, "The true object of engineering is not to create machines to which men would be bound by chains of necessity, or mechanisms to which they would become slaves. The mission of the engineer is to obtain such a mastery in the application of the laws of nature that the forces of the universe will be employed in the service of man."

Water Self-Purification

AS a result of researches by the United States Public Health Service, the widely-popular idea that running water will purify itself within a matter of a few miles, is definitely relegated to the limbo of exploded fallacies. It was also found that oxygen is not, as heretofore thought, the sterilizer, but rather is it a neutralizing and deodorizing agent for some of the gases resulting from the bacterial decomposition of organic matter.

Extensive observations were made to determine the rate of oxidation of organic matter in water and it was found to be exceedingly slow in all cases. For example, Ohio River water, sampled at Cincinnati, showed the presence of intestinal bacteria for almost 300 days although it had been "breathing" oxygen throughout that period. The Public Health Service states that "irrespective of distance from the nearest upstream source of pollution, no river water in the United States can be considered hygienically safe without treatment."

The increasing pollution of our streams is the result of the rapid growth of cities and the consequent increase of sewage. The condition is a perpetual source of possible danger and even of epidemics and it points to the necessity of treatment of community wastes for the relief of existing nuisance conditions.

A limpid woodland stream may be a thing of beauty for poets to sing about, but beware before drinking of its waters. It may be as badly polluted as its big brothers, the rivers.

JAZZ OR SCIENCE?

COMES to our desk an announcement that warms our hearts. Youths of the St. Clair High School at Odenville, Alabama, have organized the *Lindbergh Science Club*, "to develop more interest in science and actually prove things in it by experiments;" President, George Franklin; Vice-president, J. P. Handley; Secretary-Treasurer, Willard Hodges, Jr.; dues five cents a month "to buy apparatus and books." Meetings once a week.

Who says boys are no longer serious?

Who says young people know only jazz?

Who says the next generation is going to the "demnition bow-wows?"

To the *Lindbergh Science Club* of Odenville, Alabama, the editor's felicitations.

YANKEE INGENUITY

THE Worcester Polytechnic Institute has received a liberally endowed scholarship for award to the boy who in grammar and high school exhibits the greatest amount of "Yankee ingenuity." The college officers are now seeking a definition of that far-famed trait and a standard by which it can be measured.

Here is our definition:

Yankee ingenuity is that combination of resourcefulness, constructive imagination, and untiring energy in finding a practical, adequate solution for any given problem—to which may be attributed America's remarkable material progress.

But why *Yankee* ingenuity, sceptics may ask. Is the resourcefulness of Americans generally, anything more

# of View

than an outworn tradition? Are there not other groups of people equally inventive? Let us examine the evidence.

More than half of the great pioneer inventions in the history of civilization have been made in America.

More patents for inventions are issued to Americans every year than to inhabitants of any other country. This means not only a greater absolute number, but a greater number in proportion to the population.

Patent Office statistics for any given year show that more patents per thousand inhabitants are issued to residents of Connecticut than to residents of any other state. And as the Connecticut Yankee is typical of New England, the term "Yankee ingenuity" has grown to mean those traits which are by tradition associated with him.

While inventive ability, however, is to some extent preponderant in America, it is by no means a monopoly of native-born Americans. In the matter of ingenuity there is little to choose between Americans by birth and Americans by adoption. There seems to be something in our social and economic institutions and structure which brings out inventiveness.

While Yankee ingenuity is a quality somewhat intangible, it is something very, very real, for it has provided most of the rungs up which modern civilization has climbed. If the scholarship endowed by Henry J. Fuller does anything to explain it or stimulate it, the gift will be distinctly worth while.

WILL THE SKYSCRAPER ENDURE?

PERIODICALLY someone feels called upon to warn America that its towering skyscrapers lack permanence and are doomed to a rather early decay.

The latest warning comes from the other side of the Atlantic and from no less an authority than Sir Edwin Lutyens, one of the most eminent of British architects. He tells us that we "build for today without any thought of the future" and goes on to say that "it is difficult for an outsider to understand why American builders give iron work so little protection, leaving it exposed to atmospheric penetration. They will not in fact," says he, "stand more than 40 years at the outside, because their supports will be so badly weakened by rust and disintegration."

Talk such as this is so far from the truth as to be perfectly ridiculous, and we wondered where this critic had obtained his information, until on a second reading of his criticisms, we found that he mentioned certain rust-eaten iron work of Madison Square Garden which was revealed when that building was found, after 40 years of life, to be in very fine condition.

Speed, Duration, Distance

IF its early promise be fulfilled, the year 1928 will stand as one of the most notable in aviation history. Although but three months of the year have passed, the three most coveted records for speed, for continuous duration of flight, and for the longest flight over land and sea in record time have been set at new heights.

The record for endurance was brought back to America by Haldeman of transatlantic fame, and Stinson, who remained in the air continuously for over 53½ hours, surpassing the German record by the liberal margin of one hour and 14 minutes. On the same day Major Mario de Bernadi, in four flights over the 10-kilometer course at Lido, averaged a speed of 318.57 miles per hour.

This is progress indeed. It does not seem so very long ago that the world was amazed to learn that an airplane had sustained itself in the air for 24 hours. And less than a year ago, the builders of planes and engines, and if not they at least the general public, were aiming at 300 miles per hour as the possible limit.

Less spectacular, but of greater significance in its bearing on the future of commercial aviation was the achievement of Hinkler, who flew in record time from London to Australia, 11,000 miles. Leaving Croydon in a light airplane of low horsepower, he flew, alone, for 15 days without a mishap, in 15 stages, including a 1150-mile flight from London to Rome. Evidently the future of the light inexpensive one-man airplane is assured.

The rusted iron work was some unprotected steel framework in the tower which was exposed to the weather and had been completely neglected.

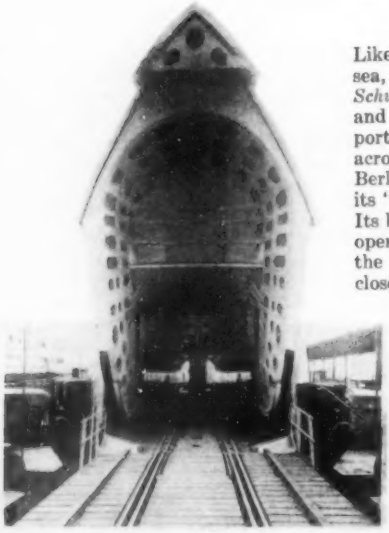
As a matter of fact, the modern steel-and-masonry American tower building should, if properly cared for, measure its life by centuries. We say the "modern" building, because the steel frame-work of some of the very first skyscrapers was not protected with the meticulous care with which it is safeguarded today, but even in the case of those early buildings, when they came to be torn down after nearly half a century of use, it was found that the steel work was in good condition.

American architects have developed the masonry-steel office building to meet the conditions of our commercial and industrial life. Its great and apparently still-increasing height is not due to any spirit of vainglory—on the contrary, we have carried these buildings to such daring heights on well considered commercial grounds. Concentration around bank, municipal, and federal buildings was desirable, and the only way to keep fairly close was to go very high. So much for that.

If Sir Edwin Lutyens had taken the trouble to look into the matter, he would have found that tall buildings have many advantages, both of an architectural and engineering character, which are inherent in the very system upon which they are built. Thus, there is an exact knowledge of the loads and the consequent stresses throughout the structure, including those bending stresses which are due to storms. Again there is an exact knowledge of the strength of the fabricated steel; the calculated loads are carried by material of which we know the elastic limit and the crushing strength.

The principal loads are static, and the horizontal wind pressures are so small compared with the vertical loads that even they may be considered as more static than dynamic. There can never be such a thing as failure by fatigue of the steel in such a building; for its maximum loading is far below the elastic strength of the steel and therefore can never curtail its useful life. So far as failure of the steel due to atmospheric action is concerned, this can be ruled out at once in considering any first-class modern steel and masonry building. The steel shapes are painted at the shops, painted again as they are being built into the office building frame, and then they are thoroughly enclosed with atmosphere resisting material such as terra cotta or fine concrete.

From the Scrap-book of Science—

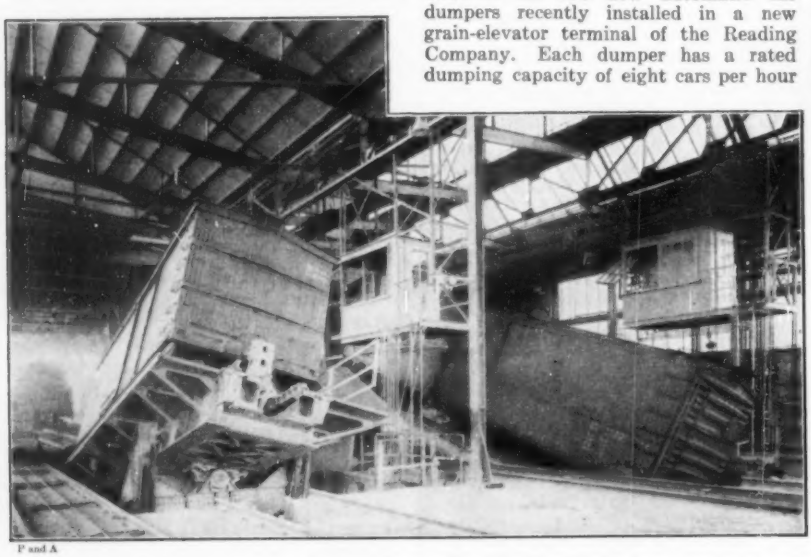


TRAIN FERRY

Like some great monster of the sea, the new ferry ship, *Schwerin*, shown at the left and at the right, which transports entire railroad trains across the Baltic Sea between Berlin and Copenhagen, opens its "maw" to receive its cargo. Its bow is like a great jaw that opens by swinging upward for the trains to enter, and then closes down tightly to protect the train from sea weather and prevent it from sliding off into the water. Twenty passenger cars and twice that many freight cars are transported on each trip between the two cities, via Warnemuende. At the left is shown the front of the ferry ship with the "jaw" uplifted and the land rails connected with those of the cavernous interior ready to receive its load. Herbert

AUTOMATIC CAR DUMPERS

This is not an indoor wreck. The two cars shown are being dumped of their contents on two new automatic car dumpers recently installed in a new grain-elevator terminal of the Reading Company. Each dumper has a rated dumping capacity of eight cars per hour



P and A

Wide World

MODEL MOON

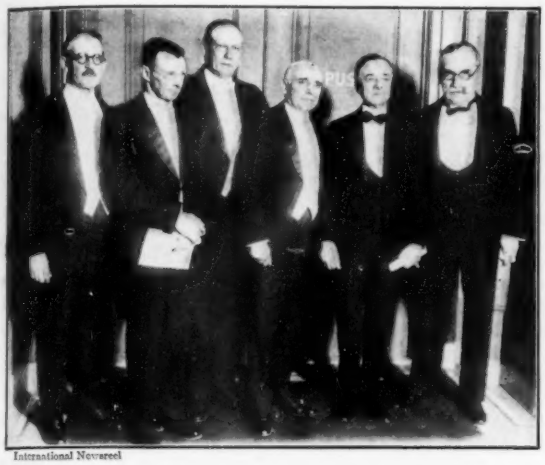
A Los Angeles optician, Mars Baumgardt, is such an enthusiastic amateur astronomer that for two years he has been working on this plaster of Paris model of the Moon. He does his work with dental tools, following photographs supplied by Mount Wilson Observatory augmented by observations he makes through two high-powered telescopes in his home observatory. When completed, this model, 40 inches in diameter, will be perfect in every detail

AMPHIBIAN

The amphibian shown here has recently been perfected by George E. Powell, of Chicago, for the customs service of the Mexican government at Yavares, Mexico. This automobile-boat has a land speed of 40 miles an hour and a water speed of six miles an hour. It is easily operated in much the same manner as an ordinary automobile, and has a seating capacity of six passengers. A 12-passenger vehicle of the same character has been constructed for Dr. T. A. Jaggar's National Geographic Society Expedition which has gone to Alaska to study the Pavlof volcano — called the "Vesuvius of the peninsula"

Underwood and Underwood

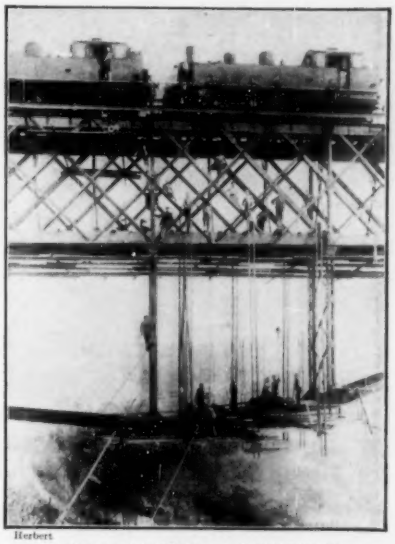
Camera Shots of Scientific Events



International Newsreel

◄ FRITZ MEDAL

General John J. Carty of the American Telephone and Telegraph Company was presented with the John Fritz Medal at a recent meeting of the American Institute of Electrical Engineers. The group shown here was present at the presentation ceremonies. From left to right, they are: Robert Ridgeway, Chairman of the Fritz Medal Board of Award; Dr. W. D. Coolidge, General Electric Company; Bancroft Gherardi, President of the A. I. E. E.; J. V. W. Reynders, who presided; General John J. Carty; and Dr. Michael I. Pupin



Herbert

TEST-LOADING A TRESTLE

Special vibration measuring instruments were used in this test of a railroad bridge at Essen, Germany, to determine its "vibration capacity"

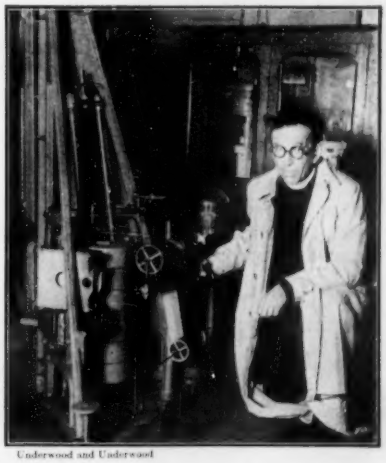
International Newsreel

◄ LANDSLIDE

When a section of Mount Serrat recently crumbled and slid into the edge of the town of Santos, Brazil, 13 houses and hundreds of people were buried in the debris. The photograph shows the gigantic proportions of the slide and gives an idea of the great amount of earth that tumbled upon the unsuspecting town with a thunderous roar, dealing death

FAMOUS SEISMOLOGIST ►

Father Francis A. Tondorf of Georgetown University is one of the world's most noted earthquake experts. The Jesuits make a specialty of seismology and take prominent part in the interesting annual deliberations of the Seismological Society of America



Underwood and Underwood

International Newsreel

"SAFETY-FIRST" TRAFFIC DEVICE

Some of the more dangerous street crossings in Los Angeles, California, will soon be equipped with this newly-developed traffic signal. When a button on a post is pressed, a red light stops automobiles and another lights the street

Underwood and Underwood

RUBBER BOAT WITH MOTOR

This "life-preserver" boat made of rubber has been successfully tried out in the Thames, London, by an Englishman. A bottom has been built into the inflated "boat" and it is propelled by an American-made outboard motor

AUTHOR AND CHIEF

With Chief Canul's most cherished possession, a "royalty" handkerchief. The author stands at the reader's right

Slowly the Past Emerges

Maya Temples Discovered in Yucatan Throw Important Light on Doubtful Points in American Ancient History

By THOMAS GANN, F.R.G.S., F.R.A.I.
Fellow of the American Geographical Society
Member of the Maya Society
Lecturer on Central American Archaeology, Liverpool University

IN 1927, while exploring the dense forests in the south of Yucatan, I came upon a series of large ruined Maya temples never before visited. These were situated in the bush immediately to the west of the Bacalar Lagoon, and were completely buried in the primeval forest with which this region is covered.

Seven temples were explored, all of which presented the same remarkable characteristics. They stood upon the summits of great oblong, truncated cones, covered with cut stone, and almost perpendicular, and were approached by steep narrow stone stairways passing up one side of the substructures. Each temple contained either one or two rooms, varying from 50 to 60 feet in length, 18 to 20 feet in height, and averaging only three feet in breadth.

THE Maya were greatly restricted in their architectural achievements, and more especially in the width of their rooms, by the fact that they never discovered the principle of the true arch, and had to resort to the clumsy expedient of overlapping courses of masonry, covered at the summit by flat flags, or capstones. This restricted the breadth of their arches to about 16 feet. But rooms of only three feet in width —hardly any of the rooms in these temples exceeded three feet and some did not even reach that—are practically unknown elsewhere in the Maya area. It is impossible that they should have been used as dwelling-places, either for the priests or nobles, as moving about in such a restricted space would have been impossible. Moreover, the back rooms in those temples which possess them must have been in almost complete darkness, and required artificial light both by day and night.

The only conclusion one can arrive at, therefore, is that the temples were used purely for ceremonial purposes, and that such ceremonies as took place in the holy of holies were performed either by artificial light or in the dark.

Each structure was surmounted by a lofty roof comb, most of which has now fallen. The total original heights of these temples were between 100 and 200 feet from the bases to the summits of the roof combs. The best preserved of them, although one of the smallest in the group, contained two exceedingly important carved lintels made of sapote wood, upon which was inscribed a date.

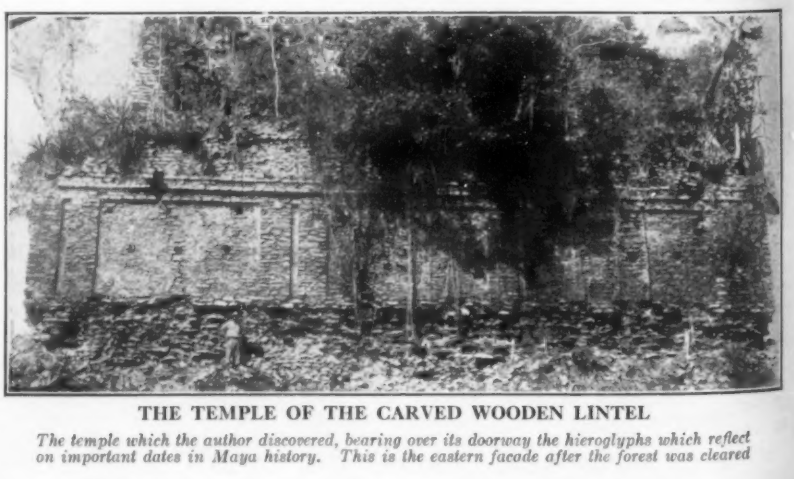
Its external measurements were: 66 feet in length, 22 feet in breadth, and 25 feet in height. It stood upon a sub-structure precisely similar to the others, but only 52 feet high. The roof comb, a great part of which had fallen, had been probably 25 feet high, so that the whole building from the ground-level to the top of the roof comb was originally approximately 102 feet in height. The temple was almost exactly orientated, its long diameter running north and south.

The outside was decorated by alternating broad and narrow oblong sunk panels. Both walls and roof comb had originally been covered with smooth stucco, painted throughout in various colors, and traces of red and green paint were found still adherent to these in two places.

On the western side of the building a steep stone stairway 26 feet wide extended from the ground-level to the only entrance to the temple, situated in the center of its western facade, and opening into the western room. The doorway had completely collapsed, probably because the lintel had been made of sapote wood, which after centuries of exposure had gradually rotted away and at last fallen in under the tremendous superincumbent weight of the roof and roof comb which it supported.

THE interior of the temple was divided into two long narrow rooms, each 57 feet long, 20 feet high and three feet wide. The dividing wall between the two chambers was five feet thick, and was pierced near its northern and southern extremities by doorways leading from one chamber to the other. These doorways were 16 feet high by five feet wide and the lintel of each consisted of three squared wooden beams placed side by side. That over the northern doorway had almost completely rotted away but that over the southern doorway, having been preserved from contact with moisture, was in an excellent state of preservation. On it were carved in low relief two beautiful little oval cartouches, each measuring 25½ by 21½ inches. Both were filled with hieroglyphics.

Cartouche A records the date of the temple. Glyph 1, on this, records



THE TEMPLE OF THE CARVED WOODEN LINTEL

The temple which the author discovered, bearing over its doorway the hieroglyphs which reflect on important dates in Maya history. This is the eastern facade after the forest was cleared

the period 18 *kins*, or days, and 4 *uinals*, or months, represented by 3 bars for 15, and 3 dots for 3, on the left of the glyph, and 4 dots for 4, above it. Glyph 2 may represent 2 *tuns*, or years, but the symbol used for the *tun* is not one previously known. Glyph 3 undoubtedly represents the day *Ahau*, with the numerical coefficient 9, that is, one bar for 5, and 4 dots. Glyph 4 is a month sign, badly obliterated, with the coefficient 3. Glyph 5 shows an ending sign, and the last 3 glyphs seem to indicate a *tun*, or year, ending in the day 9 *Ahau*, 3 (months?).

NOW in *Bactun* 9, during which practically all important events in Maya history occurred, *tun* endings in 9 *Ahau* 3 (month?) occurred 9 times, but most of these can be eliminated, either on the grounds of historical improbability, or want of resemblance between the small portion of the month glyph seen in the carving and the symbols of the Maya months upon which they fall.

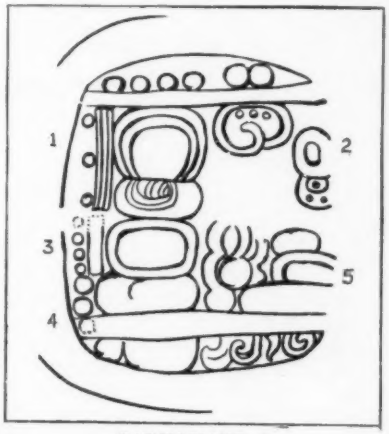
Dr. Morley of the Carnegie Institution concludes, and I agree with him, that the date most probably recorded is 9 *Ahau*, 3 *Yax*, which

CARTOUCHE B

From the temple of the hieroglyphic inscription. The wood has partly decayed

corresponds to the Initial Series date 9.15.2.0.0., 9 *Ahau*, 3 *Yax*, being 9 *Bactuns* of 400 years, 15 *Katuns* of 20 years, 2 *tuns*, or years, no *uinals*, or months, and no *kins*, or days, after the starting date of Maya chronology, corresponding to the year 474 A.D. of our era.

The country of Bakhalal—Hispanicized into Bacalar—where I found these temples, is one of the most interesting spots in the whole Maya area, for it is the first place name mentioned in the ancient Maya records, known as the "Books of Chilam-Balam," which can still be definitely associated with a known locality. Three of these books record the discovery of Bakhalal Province as occurring in *Katun* 4 *Ahau*, which Morley identified with 9.15.0.0.0., 4 *Ahau* 13 *Yax*, or A.D. 472.

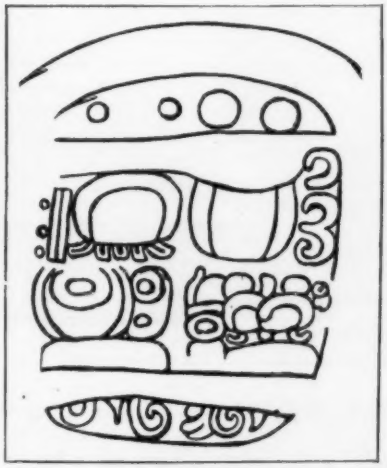


CARTOUCHE A

Compare with the photograph at the right which is less obvious to the beginner

In view, however, of the fact that I discovered a monolith (described in the SCIENTIFIC AMERICAN, April, 1926, page 233) on the Chetumal Bay, within this same province of Bakhalal, bearing the date 9.8.0.0.0., or A.D. 333, I do not consider that it is possible to accept the date A.D. 472 as that of the discovery of the province, which was the first step in the founding of the Maya New Empire.

It has always been considered that after its first discovery by the Maya



CARTOUCHE B

This corresponds to the photograph on the left, taken from the same lintel

CARTOUCHE A

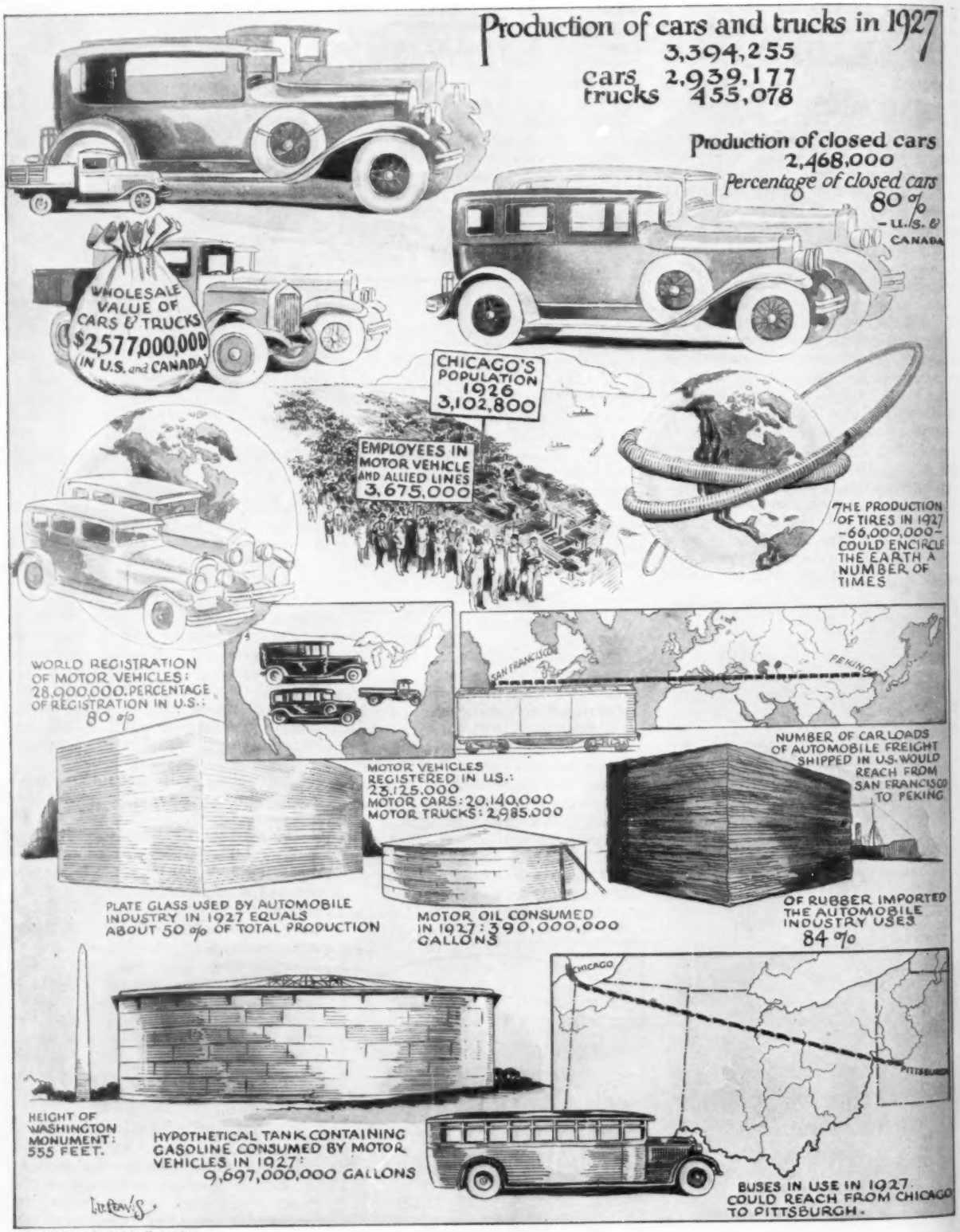
This is an actual photograph of part of the lintel bearing the historic date

there followed a considerable period, estimated at several centuries, before they founded the earliest cities of the New Empire; yet here we have in this province of Bakhalal the very gate of Yucatan, so to speak, for the Maya of the Old Empire, a series of magnificent temples and an enormous aggregation of mounds, platforms, walls, pyramids, and other architectural remains, covering every acre of an extended area and connoting not only a large population but occupation over a prolonged period.

AMONG all these relics of the past a single hieroglyphic inscription records a date. Now, it can well be imagined that extraordinary interest and importance attaches to the correct reading of this date, for on it may hinge the elucidation of the exact period at which the earliest New Empire founders entered Yucatan, and the mystery of what became of them during the centuries which elapsed between their first arrival, according to their ancient records, in the province of Bakhalal, and the next definite news we have of them when, centuries later, they founded the great city of the Plumed Serpent, Chichen-Itza, in the northern part of the peninsula.

The question naturally arises as to whether these early immigrants did not settle down here to the west of the Bacalar Lagoon, and build up the great civilization whose ruins we contemplated and not, as has generally been supposed, wander about for centuries seeking a suitable site for a permanent settlement.

I was told by the Indians that these ruins extend for miles to the north, but due to malaria I was unable to finish the work of exploration.


Production of cars and trucks in 1927
3,394,255
cars 2,939,177
trucks 455,078
Production of closed cars
2,468,000
Percentage of closed cars
80 %
– U. S. & CANADA
WHOLESALE VALUE OF CARS & TRUCKS
$2,577,000,000
IN U.S. and CANADA
CHICAGO'S POPULATION
1926
3,102,800
EMPLOYEES IN MOTOR VEHICLE AND ALLIED LINES
3,675,000
THE PRODUCTION OF TIRES IN 1927 –66,000,000– COULD ENCIRCLE THE EARTH A NUMBER OF TIMES
WORLD REGISTRATION OF MOTOR VEHICLES: 28,000,000. PERCENTAGE OF REGISTRATION IN U.S.: 80 %
SAN FRANCISCO
PEKING
NUMBER OF CAR LOADS OF AUTOMOBILE FREIGHT SHIPPED IN U.S. WOULD REACH FROM SAN FRANCISCO TO PEKING
MOTOR VEHICLES REGISTERED IN U.S.: 23,125,000
MOTOR CARS: 20,140,000
MOTOR TRUCKS: 2,985,000
PLATE GLASS USED BY AUTOMOBILE INDUSTRY IN 1927 EQUALS ABOUT 50 % OF TOTAL PRODUCTION
MOTOR OIL CONSUMED IN 1927: 390,000,000 GALLONS
OF RUBBER IMPORTED THE AUTOMOBILE INDUSTRY USES 84 %
CHICAGO
PITTSBURGH
HEIGHT OF WASHINGTON MONUMENT: 555 FEET.
HYPOTHETICAL TANK CONTAINING GASOLINE CONSUMED BY MOTOR VEHICLES IN 1927: 9,697,000,000 GALLONS
BUSES IN USE IN 1927 COULD REACH FROM CHICAGO TO PITTSBURGH.

Specially Drawn for the Scientific American

The Invincible March of the Automobile

Each year we await with interest the figures for this great industry. Statistics are piled on statistics until the magnitude of the industry becomes very difficult to portray except by the graphical method we employ. The illustrations are sufficiently illuminating to require little or no explanation. Certainly the clumsy old automobile of the late nineties has put all the world on wheels and it takes a vast army to keep them running and to service them.

Who Are The *Mysterious* Bearded Indians?

A Strange Tribe, With Strange Customs and Strange Physical Characteristics, Is Being Investigated in South America. Are They Truly Indians or Are They Descendants of Some Other People?

By A. HYATT VERRILL
Museum of the American Indian, Heye Foundation

Concerning The Author

DURING the past four years Mr. Verrill has made five expeditions to South and Central America and has visited 18 countries. On these trips he has traveled over 60,000 miles by sea and more than 6000 miles by canoes, horseback, afoot, and other means.

He has visited during the same period 33 tribes of Indians and has made ethnological and archeological collections totaling more than 15,000 specimens for the Museum of the American Indian, Heye Foundation, and the American Museum of Natural History.

In addition, he has discovered and excavated the remains of an unknown prehistoric civilization in Panama, has written seven books, has made over 100 oil portraits of Indians from life, as well as an equal number of paintings of South American views and street scenes. And still he has found time to contribute more than 150 stories and articles to magazines and periodicals in England and the United States.—*The Editor.*

MY most recent expedition to Peru and Bolivia was not, as has been stated in the daily press, in search of the bearded Indians, but was primarily archeological, although large ethnological collections and valuable ethnological data were secured among the living Indians of the interior.

The bearded Indians were merely a side issue. Moreover, I lay no claim to having "discovered" them, and neither are they a "new" race. In fact they have been known, or rather rumored, to exist for fully 200 years; but I believe I am the first to secure ethnological specimens and notes of the tribe and to bring them to the attention of science.

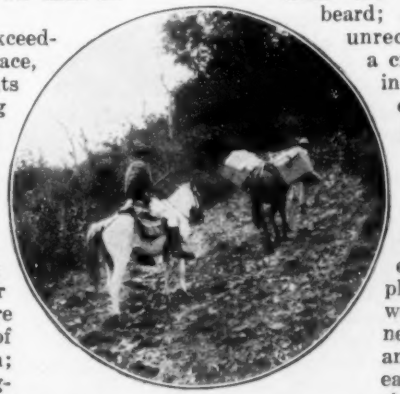
SCIENTIFICALLY, the bearded Indians are of the greatest interest, being in many ways unique, and may prove to be the key that will unlock the mystery of the origin of man in South America. Even to the casual observer they are strikingly un-Indian in appearance and have a far greater resemblance to inhabitants of the South Sea Islands than to any aborigines of America.

I have long held to the opinion that the Indians of western South America were of Oceanian and not Asiatic origin, and I am convinced that a further study of the bearded Indians will go far towards proving this opinion. The mere fact that the men are bearded is by no means the most important peculiarity of the tribe, although to the public it might seem so. Many, in fact nearly all, Indians possess beards, but as a rule these are shaved off or plucked out; and when allowed to grow, the beard is thin, scant, stiff and wiry.

The beards of the bearded Indians, however, are heavy, luxuriant, bushy, fine, soft, and slightly wavy; as is the hair on the heads. Neither are their features, their bodies nor the shapes of the heads Indian, although a comparison of their cranial measurements with those of Oceanian tribes will be necessary before direct relationships can be established or disproved.

In height they are well above the average forest Indians of South America, and in color they are darker and more of a brown than an ochre or red.

They are an exceedingly primitive race, wearing no garments whatever, having no knowledge of weaving or spinning, and not even using the bark-cloth which is almost universally used among other tribes. Their huts are scarcely more than rude shelters of brush and thatch; they have no regular villages and no chief, each collection of huts housing the members of one family or of relatives, with the head of the family acting as a local chief.



ON A MOUNTAIN TRAIL

Access to the territory occupied by the bearded Indians is difficult and slow. It is a sort of "back of the beyond" and has seldom been visited

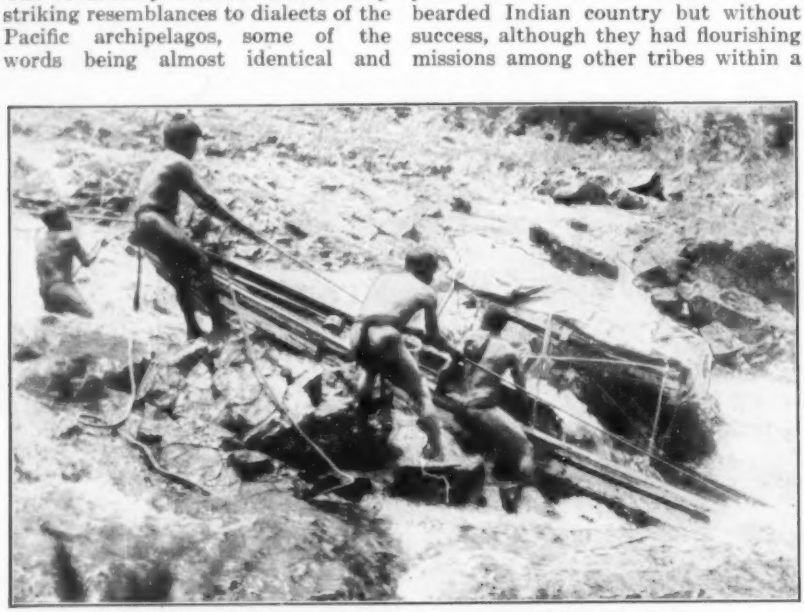
As far as I could ascertain they have no marriage ceremonies and no true religion. They believe that practically every object, animate or inanimate, is inhabited by a spirit; certain objects and creatures possessing evil spirits and others good spirits. If a tree is cut or a bird or animal killed which is supposed to harbor an evil spirit, there is rejoicing, for the act robs the evil spirit of its home and prevents it from doing harm.

BUT if any object supposed to contain a good spirit is injured or destroyed, or a creature with a good spirit killed, offerings must be made and profuse apologies and sorrow expressed. Moreover, a new home for the spirit must be provided. This may consist of a bit of hair from the Indian's head or beard; a rudely formed, unrecognizable image; a crudely drawn mark in the earth or sand; or even a bit of the hide or feathers of the slain animal or bird.

Their burial customs are very peculiar and interesting. The body is placed in a roughly woven container or net of bark and vines and is buried in the earth. After a sufficient time has elapsed for the body to decompose thoroughly the bones are disinterred and cleaned and the skeleton is suspended from a tree in a rude basket-work receptacle.

The dialect of these bearded Indians is wholly unlike any of those of the neighboring tribes. It is low and guttural but not inharmonious, and is spoken in a sing-song monotone.

The vocabulary obtained shows many striking resemblances to dialects of the Pacific archipelagos, some of the words being almost identical and having precisely the same meanings. This is not, however, confined to this tribe, for words in many of the Indian languages of western South America, even the Quichua and Aimara, in fact, show similar resemblances; all of which tends to sustain the theory that these people are all descendants of migrants from Oceania, although doubtless more or less mixed with the races of Asiatic origin farther north.



HAULING A NATIVE CANOE UP A TURBULENT STREAM

Entrance to the country of the bearded Indians is arduous work requiring a long period of time. Once there, the return journey downstream is easily and rapidly made

For weapons the bearded Indians use rude wooden clubs and bows and arrows. The latter are most remarkable, the bows being often eight feet in length and the arrows seven to eight feet long, over an inch in diameter and with feathers 18 inches or more in length and from two to three inches wide. (See page 488.) In using these gigantic bows and arrows, the string and arrow are grasped in the right hand which is braced against the right hip. The lower end of the bow is rested upon the ground against the great toe of the left foot and the bow is *pushed forward* to the full extent of the left arm, instead of being drawn by the string in the usual manner. Why these people should prefer such immense unwieldy weapons, especially as the arrows are poisoned, is a mystery.

ALTHOUGH the existence of these people has been known, more or less traditionally, for centuries, yet until recently no one had ever been able to enter or pass through their territory and live to tell of it. I was told by a Redemptorist priest that his order had been trying for over 100 years to establish a mission in the bearded Indian country but without success, although they had flourishing missions among other tribes within a few miles of the borders of the bearded Indians' district.

Not only were the bearded Indians reputed to be savage, implacable, hostile cannibals but they were well protected by nature. Their country was remote; it held little or nothing to attract prospectors or other adventurers, it was in the heart of impenetrable jungle country and it could be reached only by traveling over rapid-filled and dangerous streams.

FEW persons who have not had experience in exploring the South American jungles realize how completely isolated such a tribe may remain, or how dangerous and difficult it is to reach it. The perils of the tropical jungles of South America have been greatly exaggerated by many a traveler and even more greatly exaggerated by romancers who have never entered the jungles. They have told hair-raising tales of gigantic serpents attacking men, of poisonous snakes at every turn, of multitudinous wild beasts and wilder men, of pestilential miasmas and noxious insects.

Much of this is pure fiction. Giant snakes are not common and are not particularly gigantic, and they never molest a man. During nearly 30 years of exploration in South and Central America I have never seen or found a snake over 24 feet long, despite large rewards offered for larger specimens, and a 20-foot anaconda or boa is about as dangerous to man as an ordinary black snake here in the United States. They are sluggish, timid, and will not attack any creature larger than a small deer, for example.

Poisonous snakes are about the rarest denizens of the tropical jungles of America and are seldom seen unless one is clearing or burning land. Even when present they keep out of man's way if possible. The Indians wander barefoot and nude everywhere, and in all my years of experience I have known of only one Indian who was bitten.

Insects there are, it is true, sometimes in swarms, sometimes not, and while jiggers or chigoes, ticks and ants are at times a nuisance, mosquitoes are rarely seen except in low swamp areas. Nowhere in the tropics have I ever experienced as much trouble with insects as in our northern woods when the black fly season was at its height.

LEAST of all dangers are wild animals and Indians. There is not a wild animal in the whole of South or Central America that will attack a man unless wounded, and personally I do not believe that any Indian ever molested a white man unless the white man started trouble or unless the Indians had suffered at the hands of white men and did not discriminate. I have visited and lived among innumerable tribes, many of whom had never met white men and still more of whom were supposed to be savage and hostile, and never yet have I received anything save the most friendly and hospitable reception.

All these dangers and hardships—and the latter are enough without any exaggeration—are nothing when compared with the perils and hardships of river navigation which, oddly enough, are seldom mentioned in tales of adventure in the vast stretches

A MOUNTAIN FERRY

This device is not the work of the bearded Indians, who are far too primitive

of any of the American jungles.

And yet, in order to penetrate any distance into the interior or to reach such a country as that of the bearded Indians, one must depend entirely upon river travel. The craft used may be a frail canoe of bark or as it is called a "woodskin"; it may be a cranky dugout; or it may be a strong, well built craft with a dugout shell built up with planking. But in any case it must be small and is in constant momentary danger of being capsized, smashed to bits, sunk or hurled over a cataract. Manned by Indians or half-breeds, the craft is paddled through the short stretches of smooth water, is dragged, hauled and lifted by main strength upstream through foaming, churning, roaring rapids; is carried laboriously through the jungle around falls and, in many cases where falls are too high or too long to portage, it must be abandoned and a new boat built in order to proceed.

PROGRESS is exceedingly slow. Hauling up streams, the boat crew do well if they cover 20 miles a day, and very often only four or five miles are gained by a day's unceasing, terrific toil.

Going down stream is in some ways even worse. To be sure, progress is anything but slow. The boat sweeps through rapids with the speed of an express train, in a few hours covering the distance which required weeks of labor to overcome on the upstream journey. But the dangers are a thousand times greater. One's life is in jeopardy every instant, and I know of nothing so exciting and thrilling as to descend some unmapped tropical jungle river in a native canoe manned by naked Indians and with one's life and all one's possessions and food staked against the chance of a broken paddle, an unseen rock or an error of judgment on the part of the Indians. Tearing through the foaming water and upflung spray, missing jagged rocks and certain disaster by a hair's breadth; skirting the swirling eddies of vast whirlpools, swinging about sharp bends at the very brinks of cataracts for hour after hour, day after day, one gradually becomes so accustomed to dangers and acquires such a confidence in the Indians that it all seems a matter-of-fact, everyday affair.

AND yet, should an accident occur, should the boat be capsized, "washed out" or sunk and no lives lost—which would be a real miracle—still the explorer and his men would be face to face with death. Without outfit, arms or provisions there is not one chance in 10,000 of reaching civilization or a distant Indian village. Despite all tales to the contrary it is practically impossible to live off the tropical jungle even when equipped with fire-arms and fishing tackle. Game is scarce and wary, and, as a rule, it cannot be found when most needed, and even the native forest Indians cannot sustain life on the game and fish alone. Of nuts, fruits and roots there are practically none. What there are are usually devoured by birds and animals before they are fairly ripe.

One's only hope if thus stranded is to reach an Indian camp or village and, very often, in fact usually, an Indian village is an unknown number of miles distant. These tropical forests are very sparsely inhabited. Often, for hundreds, perhaps thousands of miles, there will be no Indians, and when they do exist their homes are usually carefully hidden near some small stream deep in the jungle, and the stranger who hopes to find succor at one of these camps usually finds the Indians short of supplies themselves.

ONE OF THE AUTHOR'S CAMPS IN THE JUNGLE

The explorer sleeps in a hammock which shows in the picture. No precaution is taken against the wild beasts of the jungle, their "bloodthirstiness" having been grossly exaggerated

WOMAN OF THE TRIBE

These people are in a more primitive state of culture than most other Indians

Once we understand this and realize the difficulties and dangers, the innumerable hardships and the heart-breaking dreary days of toil, the incessant drenching rains, the steaming heat of days and the bone-chilling misty nights which are all a part of penetrating these districts, we can understand how and why such a tribe as the Sirionos has remained isolated for so many years.

BUT, of recent years they have established a sort of armed truce with their neighbors and little by little have permitted strangers to visit their outlying homes and to trade with them. Moreover, with the improvement of transportation methods in the settled portions of the country, and with the pacification of tribesmen occupying the districts between the settlements and the Siriono country, the tribe has become more easy of access.

I cannot state positively whether or not these Indians are cannibals. I have visited many reputedly cannibal tribes, but as yet have never actually witnessed cannibalism nor found positive proofs of the custom: But there is no reason to doubt that the Sirionos are cannibals, as cannibalism is not uncommon among the tribes of the interior of Peru, Brazil and Bolivia.

¶ *Next month the author will give his reasons for the belief that the tribes he describes are not actually Indians.*

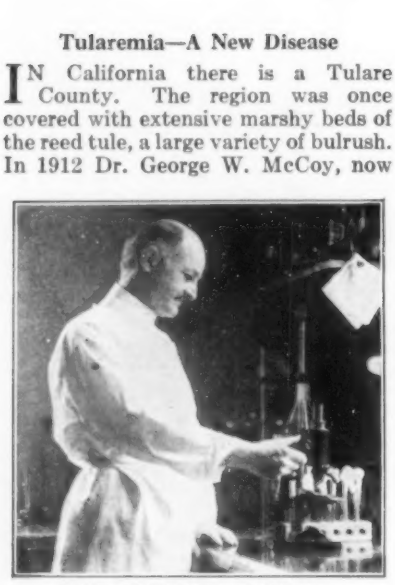
The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Tularemia—A New Disease

IN California there is a Tulare County. The region was once covered with extensive marshy beds of the reed tule, a large variety of bulrush. In 1912 Dr. George W. McCoy, now



DR. EDWARD FRANCIS

Dr. Francis fell a victim to tularemia while studying his first case of the disease in Utah. He is now devoting himself to its prevention and cure. The former is better than the latter. A surgeon uses rubber gloves when handling the inner organs of man. Why, then, use the bare hands when handling the organs of wild rabbits? If they are infected, you may contract the disease of tularemia

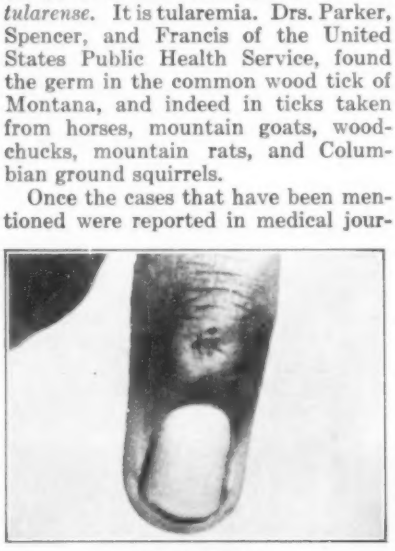
director of the Hygienic Laboratory of the United States Public Health Service, and Dr. C. W. Chapin found a germ which was causing a plague-like epidemic among the ground squirrels in Tulare County. They called their germ *Bacterium tularense* in honor of the county. Today, largely through the efforts of Dr. Edward Francis of the United States Public Health Service, the disease "tularemia," caused by the same germ, is known to be a condition affecting man as well as animals, a disease that seems to be spreading rather rapidly throughout the United States, and which has already been responsible for several deaths of human beings.

In Utah there is a disease called deer-fly fever that is due to the bite of a blood-sucking fly commonly found around horses. In 1919 and 1920 Dr. Francis found the *Bacterium tularense* in seven human cases of deer-fly fever and in 17 cases among jack-rabbits. He proved at the same time that the disease had been transmitted by the bite of the deer-fly from animal to man; deer-fly fever was tularemia.

In 1921 a man working in a Washington, D. C., market went to his doctor for treatment of what he called rabbit fever. He said that the men in the market frequently suffered with rabbit fever after handling the flesh of recently killed rabbits. From the lesions in this man also Dr. Francis was able to isolate the germ called *Bacterium tularense*.

In Montana and in Idaho there have been cases described of a glandular form of tick fever. The disease differs from Rocky Mountain spotted fever, which also follows the bite of a tick. The glandular form of tick fever turns out to be infection with the *Bacterium tularense*. It is tularemia. Drs. Parker, Spencer, and Francis of the United States Public Health Service, found the germ in the common wood tick of Montana, and indeed in ticks taken from horses, mountain goats, woodchucks, mountain rats, and Columbian ground squirrels.

Once the cases that have been mentioned were reported in medical jour-



TULAREMIA

Ulcer on finger of a victim of the disease. Infection set in after dressing a wild rabbit

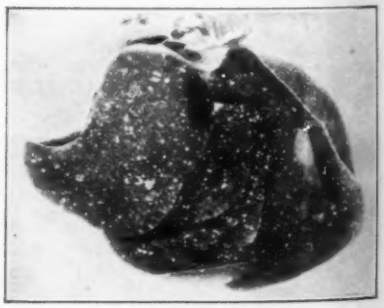
nals, physicians throughout the country began to notice the occurrence of the disease in many places, and reported its development in various ways. An engineer in Texas was bitten just below the eye by an insect. He became sick with the symptoms of tularemia and the organisms were found.

The first human case reported was a man who worked in a cheap restaurant and who handled infected rabbit meat. A woman who lived on a farm in southern Indiana handled the meat of infected rabbits and developed tularemia infection of the eye. A woman in North Carolina got the disease from handling infected rabbit meat just after she had cut her finger. A man in Virginia went hunting and got his hands badly scratched among the briars. Later he dressed five rabbits that he had shot. He became severely ill with tularemia.

The usual course of a person infected with tularemia is about like this: Some time within two to five days after he has handled the meat of rabbits, or been bitten by a horse fly or a wood tick, he becomes suddenly sick with chills, bodily pains, vomiting, weakness, and fever. Usually within 48 hours there is pain in the lymph-glands near the spot where the infection entered, either at a wound in the hands or near the spot on the skin where the person was bitten by an insect. The spot of infection gets swollen, may ulcerate and discharge broken-down material. The fever lasts from two to three weeks, may go down and then come up again. The glands may soften and get small without any further trouble but sometimes they also break down with the discharge of material. The patient is weak and convalesces slowly, usually being able to return to work after a few months.

A housewife in Minnesota skinned a rabbit and cooked it for the family dinner. Within three weeks she had died of tularemia which, in her case, did not settle primarily in the glands but attacked the system generally in much the way that infection with typhoid may do. Other fatal cases of tularemia have been reported in other states.

The United States Public Health Service has issued repeated warnings against tularemia. When a cotton tail rabbit can be run down and knocked over with a stick it is probably a sick



RABBIT LIVER

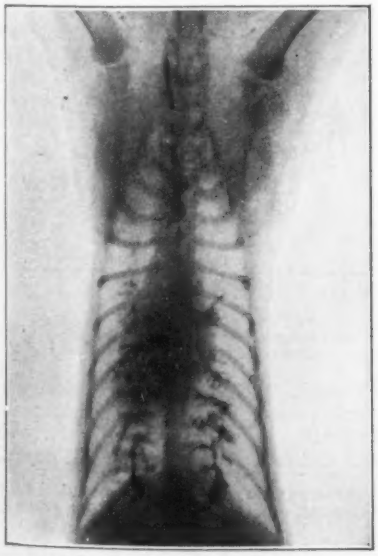
Liver of a rabbit afflicted with tularemia. The white spots are disease characteristics

rabbit and is best let alone. A jack-rabbit must be awfully sick if he can be caught by a human being on foot. The hunter with a gun will do well to give the rabbit an even chance. Let it run 30 or 40 yards before it is shot. If it can not run that far, it is a sick rabbit. The average man can hardly tell by looking at the flesh of the rabbit whether or not it is infected. The average doctor can hardly tell by inspection with the naked eye. Bacteriologic studies made with a microscope will reveal infection and a competent man can tell of its presence by careful tests that involve the taking of specimens of blood and checking them with serums that have developed the power to agglutinate the *Bacterium tularense*.

Cough

ONE of the most common symptoms affecting human beings is a cough. Although it may not apparently be a serious thing, it is always representative of some disturbance. It may be so irritating as to prevent sleep or rest and thereby exercise a most deleterious influence upon the body. The act of coughing is itself a motion of considerable effort involving action of the muscles in the lower part of the chest, the abdominal muscles, muscles of the back, and action of the diaphragm. Hence fatigue may be produced through over-action of these muscles alone.

If a person has a weak heart as the result of degeneration of the heart tissue, a cough may so overburden the heart as to bring about heart failure with resultant death. A person with tuberculosis who may have a hemorrhage from the lungs is treated by immediate rest so that the blood may clot and the hemorrhage stop. An irritating cough serves to dislodge the clot and to start the hemorrhage anew. Sometimes the cough serves to spread infection from one part of the lung to another.



DOG'S LUNGS

Three minutes after injection of iodized oil. As yet there has been no coughing

Drs. Edward Archibald and A. L. Brown decided to study by modern scientific methods exactly what happens when the human being coughs. They injected iodized oil into the trachea so that it flowed throughout the trachea, the bronchial tubes, and as far into the lung tissue as it could penetrate. This substance produces an opacity on Roentgen-ray plates. They found that when a person coughs, his lungs become more fully filled with the iodized oil than otherwise.

In other words, the increased rush of air into the lung following a cough will carry the oil into the deepest portion of the lung. Subsequent coughs may tend to expel some of the material, but assuming that infected material instead of the iodized oil had been present, the infection would have been spread by the cough throughout the lungs. Obviously then it is of the greatest importance to keep the lung quiet in time of infection and to subdue the coughing reaction under some circumstances. There are, however, instances when coughing may be considered most beneficent in forcing infected material out of the breathing tract.

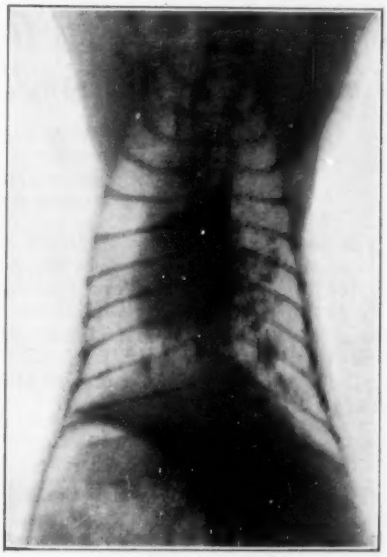
It is, of course, necessary for the physician who has made the diagnosis to determine whether or not he wishes to treat the condition by the use of sedatives or anesthetics which will subdue the cough reflexes or to use a method that will stimulate coughing for the opposite reaction.

Diseases of the Arctic Regions

WHEN persons living in the temperate zone go either to the arctic zone or to the tropics, they are likely to suffer with disturbances that are peculiar to those regions and definitely associated with changes in environment. The arctic explorers used to suffer with scurvy due to lack of substances in the diet that contain vitamin C. Since the experience of Stefansson, modern explorers see to it that everyone eats a few ounces of raw meat each week, such as the meat of the caribou, the seal, or the walrus. Meat of this type, including the liver of animals, is rich in necessary vitamins.

Americans who go to the arctic suffer frequently from headache due to ice glare, from dryness of the skin, and from secondary infections of the skin, such as boils and pimples resulting from the lowered resistance of tissue following freezing and cold. For the same reason, soreness of the feet and hands is a common symptom. Experienced explorers suggest that smoked or colored glasses fitting closely to the eyes be worn regularly to prevent snow blindness. Beyond these conditions, there are few diseases that are likely to disturb arctic travelers more than travelers in the temperate zone.

Macmillan has made seven trips



AFTER COUGHING

Showing the wide-spread penetration of the oil just after injection and induced coughing

north without the loss of or serious injury to a man. Peary lost two men, one of whom was drowned. However, these expeditions were well prepared and provided with all of the usual home remedies to take care of minor illnesses.

Candy

THE per capita consumption of sugar has risen from less than nine pounds in 1823 to more than 110 pounds at the present time. According to Dr. L. B. Mendel, Americans used in 1823 an equivalent of 44 calories a day as sugar, whereas in 1924 they used 547 calories. Today sugar constitutes one fifth of the amount of food taken in by the majority of our population. If it were taken in the form of loaf sugar it would be equal to 20 cubes a day.

It is not, however, all taken into the body as sugar, but in the form of sweetening for food, in pastries and particularly in candies, since the American nation is the heaviest eater of candy of any nation in the world. The amount of candy eaten in the United States in 1926 was 1,083,399,754 pounds, valued at almost 260,000,000 dollars. That means nine pounds of candy for every man, woman, and infant in the country. The amount is not excessive since it constitutes only about 2 percent of the total food intake of the human body. However, it must be remembered that not everybody eats his nine pounds and that some people are probably eating a great deal more than they should.

Geophysical Prospecting*

Authentic Scientific Apparatus Is Being Employed More and More to Help Locate Ore Bodies. In Addition, There Are Fake Methods

By A. S. EVE, D. Sc.,
Director, Department of Physics, McGill University
and D. A. KEYS, Ph. D.,
Associate Professor of Physics, McGill University

IN last month's issue we studied a number of the geophysical methods of prospecting for mineral wealth. In the present article we shall conclude the authors' survey and note as well that there are pseudo-scientific methods which are frauds or else are not yet understood.—*The Editor.*

Electrical Methods

Measurement of Natural Current

Rain-water seeping through the soil may oxidize the top of a body of sulfide ore more than the bottom. Then currents of electricity flow continually and naturally in the earth from the bottom to the top of a deposit, completing the circuit through the better-conducting ore. (See Figure 13.)

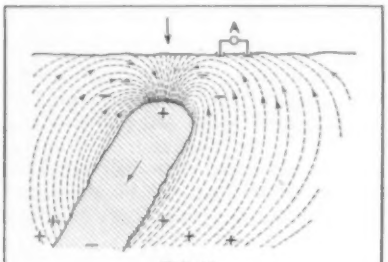


FIG. 13

ORE BODY ACTS AS BATTERY

The current lines are dotted. At A is the galvanometer and two detecting electrodes of a non-polarizable nature

IN localities where such currents exist they may be detected by use of two rods stuck into the earth and connected with a sensitive galvanometer. Thus a survey may be made, by a null method, showing curves of equal electric pressure or potential, while the flow or current of electricity is at right angles to these. (See Figure 14.) But the points or electrodes—hollow copper rods—are themselves affected or polarized at the point where they are grounded. To avoid this trouble, flowerpots or other porous pots are filled with water and copper sulfate; the copper rods are fitted into the pots, which must in turn make good contact with the ground. This scheme is delightfully simple and under favorable conditions may work well in locating some ore bodies near the surface.

Measurement of Earth Resistance With Direct Current

An alternative plan may remind engineers of the destruction of water or oil pipes by electrolysis when leaks of electric current on its return journey from street railways take a short cut through convenient conducting pipes and cause chemical decomposition there. In this type of exploration a direct current from a few dry batteries (about 120 volts) is led by wires to two "grounds" at *A* and *B*. If no ore bodies are present, the surface currents will be regular and symmetrical. (See Figure 15.) If ore lies near the surface, these currents may be distorted. (See Figure 16.)

AGAIN, detection is made as before by the rods, flowerpots, and galvanometer, and the equipotential lines are marked by stakes on the ground, surveyed, and finally plotted on the map. Here detection is possible because the ore is a better conductor or has less resistance than the surrounding earth. After the survey comes the more difficult task of "interpretation"—difficult because wet soil and rocks conduct better than dry soil and rocks; so natural features, such as springs or rivers, have to be considered, artificial conditions, such as cables and water pipes, must not be overlooked, and the geologist will contribute useful information.

Measurement of Earth Resistance With Alternating Current

For measuring with alternating current a special type of commutator is used which reverses the current sent into the soil 60 times a second. Current is obtained from a battery at 135 volts. Four electrodes are used, equally spaced about 120 feet apart. As shown in Figure 17, the two outer electrodes send the alternating current into the earth, and the two inner ones are connected through a similar commutator arrangement which rectifies the current they pick up. The potential difference between the two center electrodes is measured with a potentiometer. From the current between the outer electrodes, which is measured on the microammeter or milliammeter *G*, and from the potential difference between the two inner electrodes, which is read on the potentiometer *H*, the resistivity of the intermediate soil is found. As the resistance depends upon the nature of the ground, the method may be used for detecting ores with abnormally high resistance or those with low resistance. The arrangement might also be used for plotting equipotential lines by making the two central electrodes movable and finding their positions when they are at the same potential.

Courtesy Swedish-American Prospecting Corp.

THE POTENTIAL METHOD

The expert is inserting one of the searching electrodes into the earth

ALTHOUGH this method has not as yet been used for prospecting, it certainly deserves a trial. The department of terrestrial magnetism of the Carnegie Institution of Washington carried out the original experiments in order to determine the conductivity of soil and rocks to a considerable depth.

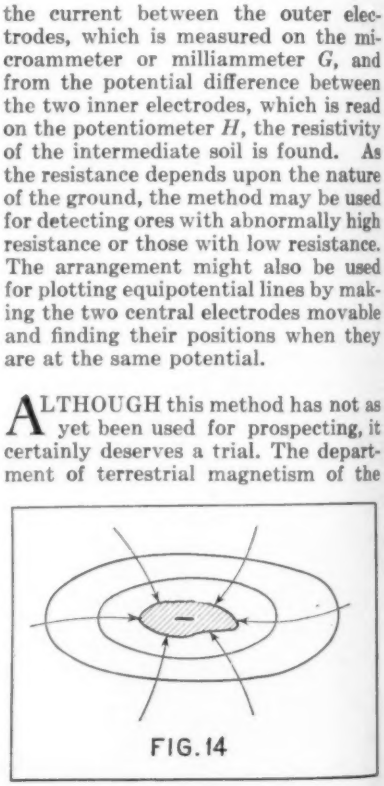


FIG. 14

PLAN OF FIGURE 13

Arrows show current flowing toward upper negative pole of ore body. Note equipotential curves centered around the ore body

Measurement of Equipotential Lines With Alternating Current, Using Point Electrodes and Telephone

Two-point electrodes are placed in the ground several hundred feet apart, and a current from a "buzzer," or in-

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duction coil, or from an alternating-current generator of about 500 cycles is put into the soil through these electrodes, as shown in Figure 18. Two other electrodes connected to a telephone, through an amplifier if necessary, are then used to trace out equipotential lines, the observer noting when the sound in the telephones becomes a minimum; one electrode is fixed, but the other search electrode is moved about. When the minimum condition

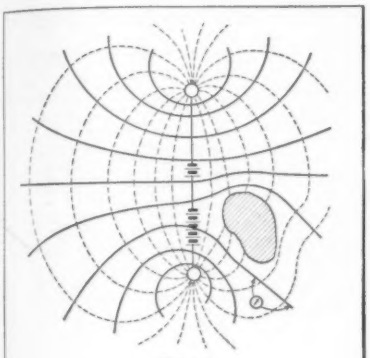


FIG. 16

DISTORTED SURFACE CURRENTS

Here there is an ore body and it spreads the equipotential lines. Strictly speaking, all of these lines, here and in Figure 18, should be shown perpendicular to the dotted lines at each intersection. Note galvanometer

is found these two points are on the same equipotential line. The lines of current-flow in a normal or undisturbed region are shown in Figure 15, and may be contrasted with the corresponding lines near an ore body that is a good conductor. The equipotential lines are actually observed, and a "null" or "silence" method is used in their determination. Equipotential lines are then plotted out all over the field, and the deviation of these equipotential lines from what one would expect in a region free from ore, indicates the presence of ore deposits.

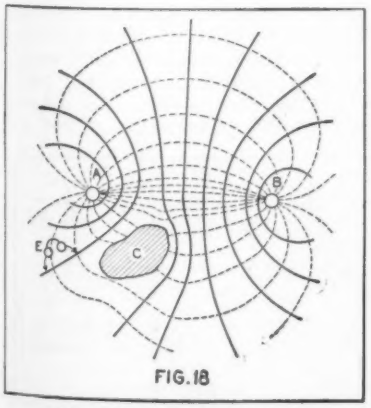


FIG. 18

ALTERNATING CURRENT METHOD

The current (dotted lines) crowds toward the ore body, while the equipotentials (unbroken lines) spread from it. Note telephone at E

Measurement of Equipotential Lines With Alternating Current, Using Long Parallel Wires and Telephone

Two bare copper conductors, about 3000 feet long, are laid on the ground parallel to each other about 3000 feet apart. The wires are connected to earth through metal pegs driven in every hundred feet. These two parallel electrodes are connected to a generator, *C*, that gives an alternating current of about 500 cycles frequency, the space between the two electrodes is searched with two exploring electrodes connected with a two or three valve amplifier and telephone, and the equipotential lines are plotted. In the absence of any ore deposits, these equipotential lines will roughly parallel the side conductors, but the presence of ore deposits will distort the lines of equipotential, as shown in Figure 19.

THE question of depth immediately arrests the attention of the mining engineer and is one that is difficult to answer, as so much depends on the nature of the ground and the size of the ore body. A large mass of low-grade stuff may give the same indications as a smaller block of pay ore.

Measurement, With a Search Coil, of Distribution of Electro-Magnetic Field Near Two Electrodes Placed in the Soil and Supplied With Alternating Current

The present arrangement involves placing two electrodes in the ground about 300 feet apart and supplying them with alternating current from a generator having a frequency of about 500 cycles per second, as illustrated in Figure 20. The region around these two electrodes is then surveyed with a search coil, which may be rotated about a horizontal and vertical axis. An amplifier and telephones are used and the plane of the coil turned about the two axes until a minimum position is obtained for the intensity of the sound. This gives the resultant direction of the electro-magnetic field at this point, and the intensity of the disturbance there is found by turning the coil through 90 degrees and measuring the strength of the current by a galvanometer or other suitable means. In this manner the direction of the magnetic lines is plotted, and the resulting map of equipotential lines is compared with that which one would expect if no disturbing ore deposit was present. Deviations of the lines from the normal distribution then indicate the presence of metalliferous deposits.

In this, as in other schemes, it is possible to use two search coils connected in series, so that the effect in one opposes that in the other, an electron tube or valve amplifier and telephone or other recording instrument being used as a detector. One coil is then kept stationary and the other moved about and orientated until silence points are obtained. In this

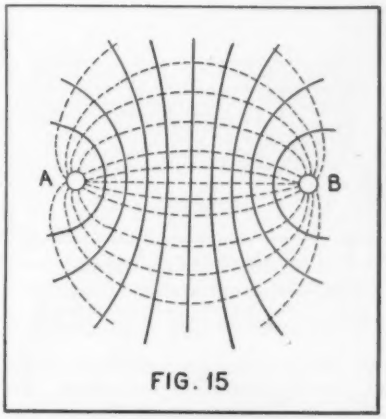


FIG. 15

UNDISTURBED SURFACE CURRENTS

The ideal or theoretical situation where there is no ore body or inhomogeneity. Compare with Figure 16, where one exists

manner curves of equal intensity are drawn, from which the presence of any distorting ore body is detected.

Measurement, With a Search Coil, of Distribution of Electro-Magnetic Field Inside a Region Surrounded by Insulated Cable in Which an Alternating Current of About 500-Cycle Frequency Is Flowing

An insulated cable is laid around a rectangular area with each side about 2000 feet long, as illustrated in Figure 21. Then the inside of the loop is surveyed with a coil of wire wound on a frame, which may be rotated about a horizontal and vertical axis. This coil is connected to an amplifier and telephone and that position of the coil for which the intensity of the sound is a

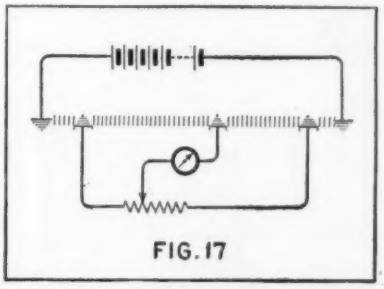


FIG. 17

ANOTHER SUGGESTED METHOD

Battery at top, connected to two grounds. Arrow in circle indicates galvanometer; zigzag, a potentiometer connected to grounds

minimum is found. The minimum sound is heard when the plane of the search coil is along the resultant direction of the electro-magnetic field at that point. Moreover, the maximum intensity can be measured by thermocouple and galvanometer, as in radio work. Both direction and intensity will be distorted or changed if ore bodies are beneath, and thus the presence of ore can be deduced. Sometimes it is advantageous to use two search coils differentially opposed to one another.

While intensity gives some indica-

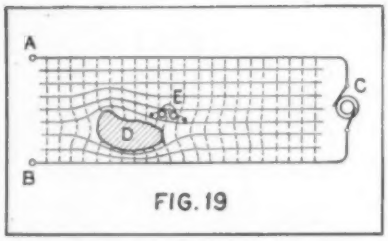


FIG. 19

LONG PARALLEL WIRES

The bare copper wires are laid on the ground, over half a mile apart. The ore body at D, distorts equipotential lines. Note telephone E

tion of the magnitude or mass of an ore body, phase difference may be a guide to distance or depth. These points are being amicably discussed by experts, and both mathematical theory and practical application involve formidable difficulties. The discussion may bear fruit in future, but in the meantime it does not hinder the practical application of the flexible electrical methods now available. Indeed, by plotting in this way both the direction of the field and its intensity at various points within the area surrounded by the loop and by comparing the resulting map with the map that would be obtained if no ore bodies were present, the presence of the mineral deposit may sometimes be deduced.

Methods Involving Use of Wireless or Radio Waves

There is a radio method which is essentially a direction-finding method resembling that for locating ships at sea. The ship sends out signals, and a coil on the coast receives maximum intensity signals when its plane points straight to the ship, and zero or minimum signals when its plane is at right angles to that direction.

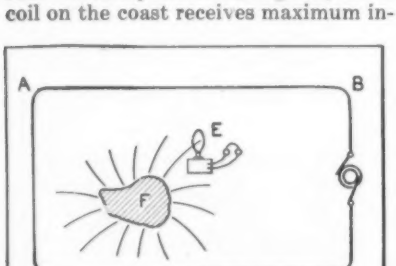


FIG. 21

RECTANGULAR WIRE METHOD

A B C D is an insulated cable with alternating current generator; F, ore body; E exploring coil. From A to B is 2000 feet

As ore bodies can not send out signals it is necessary to stimulate or excite them by primary electro-magnetic waves from a transmitter with a suitable aerial or loop. Thus a vertical loop, *A* (Figure 22), will by induction cause oscillations in ore body *CC*, and if this has length, then "carrier" or "wired wireless" waves will travel along it, or in any case the ore body will reradiate secondary electro-magnetic waves which may be detected by a vertical coil, *B*. Unfortunately, the coil *B* will also receive more powerful waves from the loop *A*, and these will, in general, arrive out of phase, so that direction finding seems at first hopeless. This difficulty has been met by altering the frequency in the loop, tuning the coil to the loop until the signals from loop and ore body are in phase; a sharp minimum is then observed if the plane of the direction-finding coil points in the resultant direction due to the two sources—the loop and the ore body. Thus the direction-finding coil, when moved across a stimulated ore body, will for minima have its plane pointing toward, but below, the body. In Figure 23 the vertical lines *H* represent vectors caused by the primary waves from the loop, and the shorter inclined lines *A* vectors caused by the ore. If parallelograms are completed the resultant directions point downward below *O*. The frequency in the transmitter and loop is varied by equal steps of 5000 from 150,000 to 19,000 cycles per second, involving about 25 steps; and for each step the receiving coil is rapidly tuned, the minimum observed, and dip and azimuth noted. The corresponding changes in wavelength are 2000 to 16,000 meters.

It is claimed that in either dry or wet weather, indications of an ore body of some length and volume can be received from depths not exceeding about 500 feet, provided the ore is a metallic, and therefore conducting, material, such as pyrites.

Little information is available on the penetrating power of radio waves through rocks and different types of formations, but in theory the penetration should depend upon the conductivity and the dielectric constant of the medium. About 50 feet is the greatest distance to which any radio waves will penetrate sea water, so one should expect the moisture content of the soil to have an important effect.

EXPERIMENTS by the Bureau of Mines at Pittsburgh and by one of the writers and others at Montreal show that short waves (40 meters) will not traverse many feet of rock. Broadcast waves (400 meters) appear to do better, and longer waves (10,000 meters) can be detected with good amplification in a mine or tunnel under several hundred feet of over-burden. It is extremely doubtful in all these experiments whether the waves actually came through the rock or whether they came along rails and wires. At present there is no certain answer to this question, and it deserves thorough investigation. It is certainly remarkable that in the present method, primary waves should penetrate to a considerable depth, stimulating the ore body, and that in turn the secondary waves should repass to the surface through an equally thick layer. It is suggested that we have to deal with induction rather than radiation, as the distances involved are all small compared with the wavelength. An academic opinion on this question has small importance; only actual experiments and tests in the field can settle the matter.

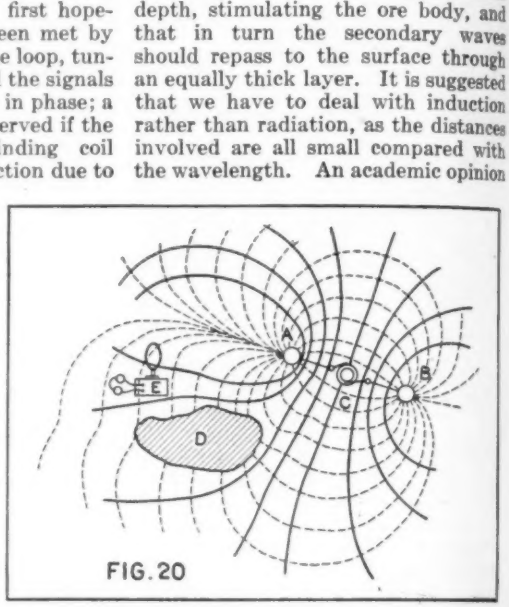


FIG. 20

AN ALTERNATING CURRENT METHOD

A and B are the grounds; C is an alternating-current generator; D is the ore body and E is the amplifier and telephone receiver

Seismic Methods

When a bomb is exploded the sound travels through the air, and the shock passes through the ground. The shock (compressional wave) from about 150 pounds of dynamite buried approximately six feet in the ground can be detected as far as about six miles with a suitable seismometer or earthquake recorder.

THIS instrument records photographically on paper, moving about four inches a second, and a wireless record of the time of explosion, as well as the shock at the observation point, are marked on the roll. The distance between the explosion point and the

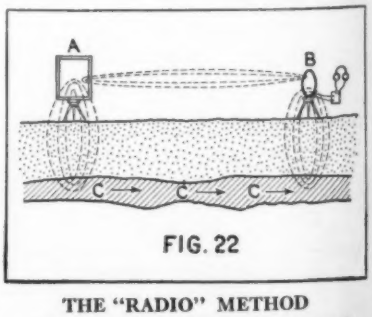


FIG. 22

THE "RADIO" METHOD

This method has been given some bizarre publicity, owing possibly to the word "radio"

observer is accurately known, thus the velocity of the shock wave can be measured. The wave first arriving has come by the quickest, not the shortest, route. Sound travels about 1100 feet a second through the air, about 6000 feet through rock near the surface, and still faster underground; in some salt domes the speed is said to reach 16,000 feet a second. Quick arrival of the shock wave is an indication of the presence of salt domes under the overlying clays, et cetera. The region near the Gulf of Mexico is being rapidly explored in this manner.

It has been already stated that earthquakes and earthshocks may be detected and the distance to their origin measured with the aid of seismographs; the general plan of these instruments embodies the inertia of large masses or weights that are so supported as to have a slow period of swing or natural oscillation. When the shock arrives the earth moves, as do the supports and recording apparatus, but the suspended mass is "lazy;" it has inertia, and tends to remain at rest.

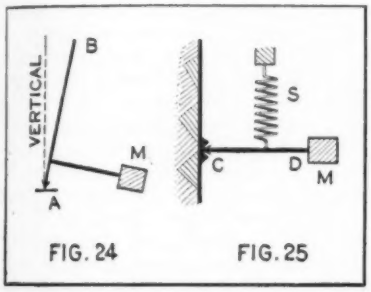


FIG. 24 FIG. 25

SEISMOGRAPHIC PRINCIPLES

The out-of-plumb pendulum at left swings slowly, like a door slightly out of plumb. At right is another type of seismograph shown in simple form to give the principle

THUS a mass, M, connected rigidly to a rod, AB, which is pivoted at A and B on a solid support is adjusted so that AB is a little off the vertical, and the whole constitutes a horizontal pendulum having a long, adjustable time of swing. (Figure 24.)

So, also, a mass, M, at the end of a rod, CD (Figure 25), pivoted at C to a firm support and suspended by spring S, represents the type of a vertical pendulum.

There are elaborate seismographs of such types, magnifying several hundredfold the actual motion of the earth, devised by Milne and Shaw, Galitzin, Woods and Anderson, and others. On the other hand, a heavy ball at the end of a cord or spring with multiplying lever and mirror will serve as a seismic recorder or indicator, such as that of Mintrop. It is desirable, however, to have a sensitive instrument with a magnification of the order of 10,000, so that a good record may be obtained of the nature of the explosive wave, for experience has shown that under favorable conditions the records are reliable and repeatable. With increased sensitiveness new troubles, however, arise. The seismograph must be on a rigid platform firmly fixed to the ground by three conical pegs. The wind may shake trees, sea waves and traffic may produce effects, and local bodies may reradiate the oncoming seismic waves.

In general, the velocity of waves depends on the density and elasticity of the medium. Low density and high elastic constant each increase the speed. On both counts the velocity is greater in the underlying salt of a salt dome than in the clay overburden. The quickest route from source to observer (Figure 26) is therefore along $SABO$, not along the short cut SO.

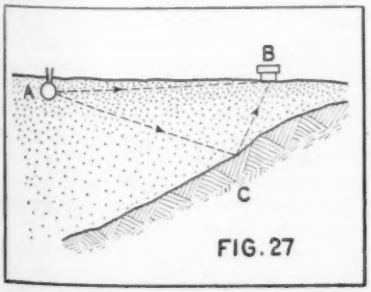


FIG. 27

REFLECTION FROM FAULTS

Charge is exploded at A; B *is the seismograph;* C *is a fault in the rocks, which reflects the waves upward toward the surface*

THE possibility of reflection must not be ignored; indeed, reflection methods are coming into use, but the time of the path ACB may nearly equal the time of the direct route AB (Figure 27), because velocity increases with pressure and depth, on account of the increase of elasticity with small change of density.

When more skillful analysis of the records has been achieved and more experience gained, it is reasonable to hope that mining men and geologists will be able to have a flood of light thrown on the existence of faults, dips, or any abrupt discontinuity in density or elasticity. Meanwhile, powerful financial interests, well equipped and aided by many leading physicists, are making systematic surveys over large regions in the southern states and Mexico; next will follow more local exploration for oil with a view to estimating the best positions for sinking wells; the torsion balance and seismic and magnetic methods will be used to supplement geological knowledge.

Finally, there will arise the difficult question as to the use of seismic methods in rocky or mountainous regions where the records will certainly be highly complex and difficult to interpret. In such places electrical or magnetic methods certainly hold the field at present.

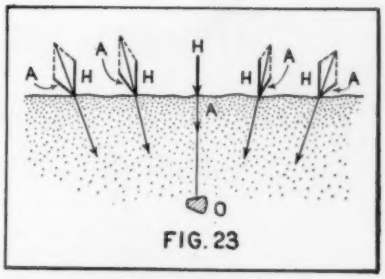


FIG. 23

"RADIO" METHOD—SOLUTIONS

Upright lines H *indicate effect of primary; lines* A *show effects of induced current*

Conclusions

In this review no account has been given of some secondary or subsidiary methods, such as the use of the electroscope in the search for radio-active rocks; of sound waves; or of temperature gradients in relation the heat conductivity of various strata, which may indeed give information useful to the geologist.

THE statement may be made without hesitation that all the methods under review are based on rational and scientific study; they use definite physical principles which are known and, broadly speaking, understood. Thus they have nothing in common with the divining rod, or "doodle bug," which is not rational, not scientific, and not based on physical principles that are either known or understood. That is to say, in plain English, the divining rod is either a fraud (whether deliberate or unintentional) or is based on some physiological principles of which at present we know little or nothing—like the sense of direction in migrating birds and fishes. Certainly we may regard with suspicion a method that for centuries has been used to detect ore, water, and witches.

In conclusion, the reader is reminded that just as a golfer selects a

(*Please turn to page* 561)

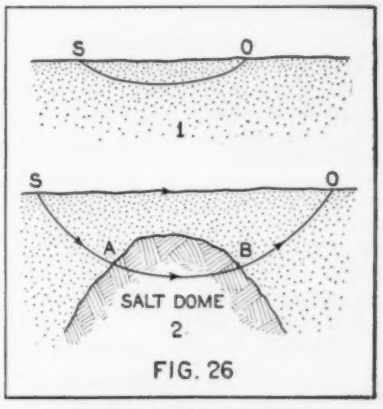


FIG. 26

FINDING SALT DOMES

Salt domes often mean oil; numerous important discoveries have been made by this method, especially in Texas and Oklahoma

Sun-spots in Weather Prediction

It Is Now Impossible to Predict the Weather From Sun-spots, and Such Predictions Need Not be Taken Seriously

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

THIS is a good year for sun-spots: not a day passes when there are not some upon the solar disk and moreover, they are often numerous. Indeed, we are close to the time of sun-spot maximum and it is not likely that we shall be able to observe greater solar activity for a decade or more to come.

Yet, although one can say so much with certainty, he would be a bold—indeed an over-bold—astronomer who would declare with assurance that the time of maximum was actually past or was still in the future. Sun-spots are short-lived affairs; new ones are appearing and old ones fading out almost daily at such a time as this, and the number in sight varies irregularly from day to day and from week to week. When averaged over a whole year, as is done in more extended studies of solar variation, these fluctuations "iron out" for the most part and a fairly smooth curve is obtained showing the well-known rise and fall of the spot numbers at intervals of a little over 11 years.

BUT when the time of our average is shortened to a month, the irregularities are conspicuous. We cannot well determine then the time of sun-spot maximum until it is already well past. We are in the position of a sitter by the seashore keeping his eye on the surf and watching for the time of high tide. The waves come in and run up along the beach, some farther than others. While the tide is rising briskly the general tendency for a new wave to advance beyond the limit set by its predecessors is obvious, but about the time of high water, wave after wave reaches almost the same mark, and although one should run beyond the limit of all the others it may still be that the tide has begun to fall and that this particular wave was a very big one.

It will not be until next year, then, at the earliest, that we can say whether 1928 was the year of sun-spot maximum.

Someone may say, however, "We know the period of the recurrence of sun-spots and have many good determinations of the time of maximum in the past. Cannot we count ahead from these and so calculate the time of the present maximum; indeed, even predict it?"

IF sun-spots were exactly regular phenomena this would be practicable, but they are not. Indeed, they afford perhaps the finest of all examples of an irregularly periodic phenomenon. The number of spots and the solar activity generally is at a maximum at intervals of about 11 years on the average; but only on the average. The interval between successive maxima has sometimes been hardly more than nine years and sometimes has exceeded 13. The curve showing the change in spottedness year by year looks in general like a succession of waves, but the waves are neither of the same length nor of the same height.

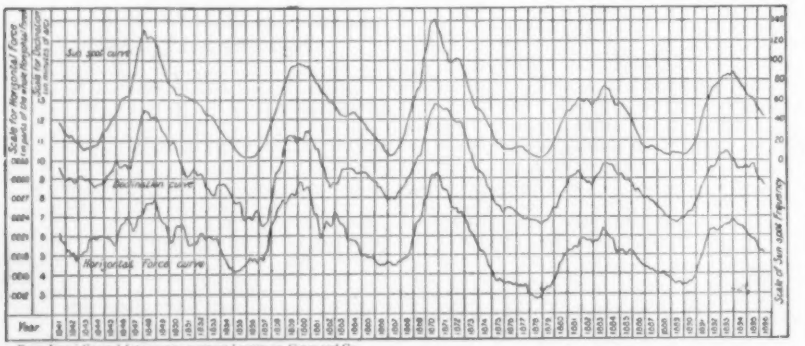
We have evidently to do, not with something *regularly* recurrent and determined by simple causes like the eclipses of Jupiter's moons, but with a thing that is *irregularly* recurrent and depends on complicated conditions like, for example, the eruptions of a geyser. "Old Faithful" is very regular—for a geyser—but although his eruptions come at intervals of a little more than an hour, they would hardly do to set a clock by, and a photographer who waited since the hour and minute of the last eruption for just the average time and then exposed his plate without looking further, would not be likely to get much of a picture.

With the geyser the gradual accumulation of heat deep down its ascending tube continues until the steam is formed with such a pressure as to blow the water out in a great fountain. When this will happen again depends on minor details of the last outburst—how much of the hot water has blown out, how much cold water ran back into the tube, and many other things. So, if the successive blow-outs come to a time within 10 percent of the average interval we may be surprised at their regularity.

The activity on the Sun's surface, of which the appearance of the spots is the most conspicuous symptom, arises in all probability from some deep-seated accumulation of energy which causes a gradually increasing turbulence of the surface and in turn exhausts itself so that there is a year or two of quiescence before the new disturbance begins. Here again the duration and violence of each outbreak appears to be conditioned by a multitude of things, some of which we cannot observe and some of which we can accurately predict. The successive cycles of activity are therefore different in length and intensity and only a very general sort of prediction is possible.

NO better evidence of this could be given than the failure of repeated attempts to predict the solar activity. Competent mathematicians using reliable statistics covering a century and more, after great numerical labor, have more than once derived complicated formulae which represent the observed run of spot numbers year by year for the whole century in a quite satisfactory way. But when it came to prediction, the formulae always failed and sometimes failed ludicrously.

In one case a formula derived by a skilled calculator from 100 years' observation predicted a spot maximum only a few years subsequent to the time which the observations covered—and the number was actually a mini-



From Jones' General Astronomy, courtesy Longmans, Green and Co.

CORRELATION WHICH CANNOT BE USED IN WEATHER PREDICTION

Smoothed curves of sun-spot frequency, compared with corresponding curves showing the variation in diurnal range of the magnetic elements of declination and horizontal force

mum! The fault here does not lie with the arithmetic or with anything mathematical. It is rather a question of physical insight—the application of a mathematical formula perfectly well adapted to the solution of problems of a certain kind, to a problem of an inherently and radically different nature.

There is no reason to suppose that any mathematical formula whatsoever will predict the number of sun-spots because, as has just been explained, they depend on a complex set of antecedents too numerous, too intricate, and too little understood to be represented by any formula of present-day mathematics.

If this may be said of the prediction of spots upon the Sun, what shall we say of the attempt to predict the influences of sun-spots upon the Earth? The writer has received various letters on this subject of late which have moved him to say something on the matter.

There are certain things which happen on the Earth which are known to be closely connected with the activity of the Sun. The daily range of variation of the magnetic needle which not only fails to point true north but points differently by a tenth of a degree or more during the 24 hours, rises and falls in a very close correspondence with the spot numbers. Displays of the aurora are far more numerous when spots are plentiful, and the disturbances of the Earth's magnetism known as magnetic storms behave in the same way. The latter are associated with electric current in the Earth's surface, which sometimes disturb telegraph and telephone currents. Here at last we come on something of practical importance and it may be that some day these disturbances can be foreseen to a sufficient degree to aid in keeping communication open.

SUN
EARTH
WHAT ACTUALLY OCCURRED. THE EARTH WAS STRUCK BY A BEAM OF ELECTRIFIED PARTICLES BLOWN OUT BY A HUGE SUNSPOT. TERRESTRIAL MAGNETISM ALSO RESPONDED TO THIS SHOCK.

Courtesy Illustrated London News

HOW SUN-SPOTS SOMETIMES AFFECT THE EARTH

Sun-spots often cause magnetic storms and auroras, as happened in England in 1926 when this drawing was made, but we cannot predict the sun-spots, much less their individual influence if any, on the weather. Nevertheless, predictions of this kind are being made and sold to people whose faith in them is virtually inextinguishable. Anyone can guess at the weather

BUT the public always asks about the weather. Now an enormous amount of work has been done on the question of whether there is any connection between sun-spots and the weather. Many competent men have handled it, discussing vast masses of statistics by reliable methods and the upshot of it all is that the influence of sun-spots on the weather is exceedingly small.

In some parts of the world it is a little warmer on the average when spots are numerous, in others a little cooler. But "a little" means a fraction of a degree. The labor involved in detecting so minute a change is enormous. One must have observations covering at least four or five spot cycles, that is, more than 50 years, to be sure that one is not misled by chance happenings; and the mere job of taking averages is a big one. Small effects which only come clear if the much larger casual variations due to other causes when an average over many years can be taken, appear sometimes to exist. But they are so small in comparison with the other variations that their influence in determining the type of weather on different days, or even the average weather for a whole year, may safely be ignored.

The other causes are so much more influential that to depend on a study of sun-spots to predict weather "is like watching an ant to predict which way an elephant will go." This trenchant phrase, which the writer heard recently from Professor Brown of Yale—as good an authority on such matters as could be found anywhere—summed up the whole situation.

THESE remarks do not apply to the serious attempts which are being made to investigate a possible connection between the small changes in the amounts of heat which the Sun sends to Earth (the solar constant) and weather conditions. In some regions where the course of the weather is unusually regular from month to month, such connection may exist, but even here little is known as yet, and it is well to be cautious in prophesying what may—or may not—happen in the future.

Meanwhile, if someone—usually someone with little mathematical or physical training—attempts to predict weather from sun-spots, the rest of us need not take it very seriously. And if he offers to sell these predictions, we may well save our money.

¶ *The Stevenson Act by which the British attempted to control rubber prices stimulated American efforts to produce rubber at home. One of these efforts, the cultivation of guayule in California, will be described next month*

A Business That Lives By Invention

Getting Display Space in Store Windows and on Counters Requires a Continuous Flow of Original Ideas

Mr. Einson

By MILTON WRIGHT

THE life blood of some businesses is invention. Stop the flow of new ideas and the business dies. A notion and novelty manufacturing establishment might be such a business—although only to a limited extent, for, paradoxically enough, there are old novelties which go on and on for years. A better example of the necessity for constant invention is furnished by the business of providing store window displays for manufacturers of nationally distributed articles.

We sought the leading figure in this line—Morris M. Einson.

"Just how does invention apply to the window display business?" we asked.

"We find it necessary to invent all kinds of schemes and trick devices to get dealers to show in their windows articles which they otherwise would not show," he replied. "Window display is a form of advertising, but it is different from other forms — street car cards, newspapers, magazines, billboards, and the like—because you cannot contract definitely for the space you will give the advertiser in return for his money.

"YOU are wholly at the mercy of the dealer. Some houses have tried to insure space by paying money to the storekeeper, some by giving him free goods, some adopt other methods, but all these are costly and unsatisfactory. The manufacturer who refuses to pay tribute has a real problem on his hands. And so it is that we constantly must be inventing schemes to get the dealers' windows."

Einson's career illustrates the truth that a man generally succeeds best when concentrating his efforts in one field. Since boyhood his work has led straight to the business of inventing window display devices. Leaving school in Philadelphia at the age of 12 to work at odd jobs, he spent his evenings in a manual training school studying mechanical drawing, modeling, and carpentry. A year later he took a job as an all-round helper in a small sign-painting shop. His employer went out of business before another year rolled round and young Einson found himself out of work.

"I LOOKED everywhere but I couldn't get a job," he told me. "Nobody wanted to hire a 14 year old boy, so I went into business for myself. I painted a little sign reading: 'Morris Einson, Signs' and hung it beside the door of the little three-room house we were living in. Then I went out and got orders for signs to paint. I just had to get business for we didn't have very much money, and, as the eldest of eight children, I was one of the principal breadwinners."

"Could you make the business pay?" we queried.

"Oh, yes, after about a year it had grown so that I was able to move to a larger place—a store with two show windows. By another year I had several employees. We were directly across the street from the National Athletic Club, a circumstance which led to a lot of work, and we eventually did the sign painting for all the athletic clubs in Philadelphia. We did quite a business."

"But why did you give it up?"

"They carted me off to a hospital with painters' colic and lead poisoning. When I got out the doctors advised me to quit the sign business. I sold out, came to New York and landed a job as an apprentice with Binger, the country's biggest show-card man."

"As an apprentice?"

"Yes. This was a different line, you see. I had been painting signs. Binger's specialty was show cards."

"After one month I took a job as a show card writer with a department store. Six months later I entered the show card department of Strauss and Company, manufacturers of electric signs. They do most of the work done for theaters. A few months later I was made foreman of their show card department. We used to call such men foremen in those days; nowadays they call them art directors."

"But why all this going from one job to another? Was it just to get a better position each time or did you have some definite object in view?"

"I had a very definite object. I wanted to get back with Binger as the head of his business, and remember, his was the biggest in the country. I knew that if I had stayed with him and worked up it would take years. On the other hand, I could come in from the outside and command big money."

"Did it work out that way?"

"IT did. I had built up quite a reputation as an expert letterer and Binger bought out Strauss' show-card business to get my services. I was taken over by Binger and found myself in charge of production in the place where not long before I had been an apprentice.

"With Binger I remained two years. In that time I introduced many innovations—things which made short cuts in the work. It was at this time, too, that I made an invention out of my regular line—a process using a battery of air brushes for coloring ostrich feathers. I also devised a process for stenciling designs on quills and feathers for the millinery trade. I then called on the millinery trade to see if there was a market for what we had. Convinced that there was, I left Binger

A SUGGESTION FOR THE HOSTESS

The ice box compartment built in to hold six actual bottles, was designed to promote sales by the case rather than by the bottle

and went into the feather business with three friends. We got up sample lines and spent six months in developing. By the time quantity production was about to start I discovered there was too much competition. We dropped the business. I learned from that experience that a man usually stands a better chance in a familiar business."

"WAS that your first patent?"

"That wasn't a patent. I doubt if I could have obtained one. A similar process was used in tinting post cards. My first patent had been taken out years before when I was learning show card lettering. It was for a collapsible desk to be used by artists and draftsmen in small rooms. I went to a dozen furniture manufacturers with it but the best I could get any of them to say was that if I wanted to give them an order they would be glad to manufacture it. I thought there ought to be a good market for it—I still think so—but the furniture people didn't have the confidence I had."

"Did you go back to Binger when your feather-tinting venture collapsed?"

"No. My partners broke away and I turned the shop into a show-card shop. To get business quickly I went to the big sign companies and sold them the idea of encouraging the show card business as a means of keeping in contact with their customers for sign business. You see, a man may want a big sign only once in two years, but he will want show cards every two weeks. If you do not keep in constant touch with him then you are in danger of not getting his business when he is ready to place it. With this selling argument we immediately secured enough business to pay all our expenses. Then we went out to get additional kinds of business.

"The Hudson-Fulton celebration gave me an opportunity to do work that attracted attention. I made life-size pictures of Hudson and Fulton which were used in many prominent stores. The International Correspondence School had an especially elaborate display in their store window. In 1909 I won a prize offered by *Signs of the Times*, the organ of the sign business. This led to my becoming a regular contributor and then editor of their show-card department. Our shop got a sort of reputation as headquarters for show-card ideas.

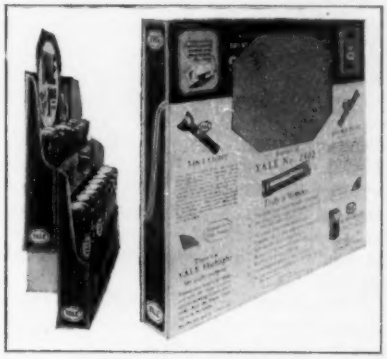
"ADVERTISING in those days was largely a matter of catch words and catch phrases. We would get up something we thought was very tricky and sell it to a national advertiser. Our idea was to get the sign painters to put in a side line of show cards. They would buy these cards from us and supply their local merchants with them. In 1911 we made a display for the National Child Welfare Exhibit at the 72nd Regiment Armory. There were 480 panels, each of them four feet by eight. This was a big order in those days and it brought us in about 6000 dollars.

IT MUST BE GOOD

In sustaining the patent for the display container the court called attention to sales of six million

"Our business grew steadily. In about a year and a half we moved to a Broadway location where we had a large store and 30,000 additional square feet for manufacturing purposes. I was now in direct competition with my old boss, Binger. We had show windows in our store front and they were filled with stunt stuff calculated to catch the attention of passers-by. Our equipment consisted of a hand-press, an embossing machine and a couple of offset presses. We were working in semi-mechanical fashion.

"We began making mechanical signs; one of them showed an airplane race, another was a big figure of an Indian whose extended arms moved in and out,



A TWO-PURPOSE DEVICE

A dealer receives a package of flashlights and folds back the cover. Presto! He has a completely filled counter display stand

stretching a pair of suspenders to show strength and elasticity, another was a man stropping a razor, and it is interesting to note that this mechanical device could strop a razor far better than any human could do."

"Did you patent those inventions?" we interrupted.

"GENERALLY, we did not," he replied. "Usually we did not think of them as inventions. We would get the ideas and go ahead and make them. Generally the amount of money involved did not justify the expense of a patent.

"After we had been on Broadway about a year we discovered that the show-card business in itself did not have the possibilities of a business that catered to advertising on a quantity basis. We were spending too much creative ability to produce things which were sold only in small quantities. We shifted our efforts from retailers and went after larger organiza-

THE WARES ARE THEIR OWN BEST ADVERTISEMENT

Mr. Einson's organization works on the theory that the function of both window and counter displays is that of a salesman. By ingeniously devised lithograph settings about the article, the prospective customer is led to desire it strongly enough to ask the salesman to sell it

tions. The first real order we got was from the General Cigar Company for displays to be used on a number of brands. This order amounted to over 60,000 dollars."

"How did you land such an order?"

"We went to the cigar company and interviewed them about the number of dealers they had, the nature of these dealers and the kind of displays they had been using. Then we visited about 50 of the larger dealers. With this knowledge added to our long experience in dealing direct with storekeepers we made a number of sketches for display cards and asked that they be tested. The order resulted from the test."

"Was your work any different from displays that had been used before, or was it just a little better?"

"It was different. Instead of using trade lithographed displays like everybody else had used we introduced a combination of lithograph and air brush. This gave new tones to the pictures and gave them a hand-made appearance. It was especially attractive and unusual. It was the first time it had ever been done for a national advertiser. We had the advantage over regular lithographers because we had had years of experience with retail dealers. These dealers had been in the habit of coming to our store and selecting signs from our shelves and paying for them. It had been necessary for us to know just what the retailer would want. As we got farther and farther in the field of national advertising other lithographers tried to duplicate the kind of work we were getting out and we found it necessary to resort to a series of schemes to produce material that had better attention-getting value and real merchandising value. As the competition for windows became keener we had to use all the experience we had gained in the retail field."

"DID you not find it necessary to protect yourself against imitators by getting patent protection on your ideas?"

"Yes. Earlier in our business we had not done very much patenting. In the first place what we produced was merely of local interest, and in the second place, we were reluctant to spend any more money than was necessary. In later years we were better able to afford patents because as we went after bigger business the returns warranted it."

An especially trying period for many national advertisers was the year 1922 when the American public went on a buyers' strike. Mr. Einson worked out a series of "Buy Now" posters and organized a National Prosperity Bureau to distribute them. This series of posters and accompanying literature was sent out to every Chamber of Commerce and business men's league in the country. President Harding, Secretary Hoover and other officials endorsed the plan which outlined a means for each Chamber of Commerce to put on a prosperity drive. Newspapers and magazines were used, and it is said more than 2,000,000 dollars was spent.

"JUST how do you devise these displays and what do they accomplish?" we queried.

"For an example," he answered, "suppose we take ginger ale. For the Canada Dry Company we made an angle panel display held together by a front curved section representing a silver champagne bucket. Between the bucket and the background an easel was arranged to hold an actual bottle of Canada Dry ginger ale. Remember, it is the actual goods we want to display.

"We also made a counter stand—the first display stand used by the company. It showed the top of a dresser

PSYCHOLOGY AT WORK

We all cannot have silver champagne buckets, but we can have the kind of ginger ale which the display implies goes with them

on which stood a beautiful doily and candelabra, silver plate, and two champagne glasses, with provision for an actual bottle of Canada Dry to be set in place. We made more than 100,000 of these display stands.

"FOR Clicquot Club ginger ale we illustrated an actual ice-box, a compartment of which was built in to hold six actual bottles. The Clicquot Club Eskimo character was in the foreground, attached by a hinged plane, wheeling a serving table and sandwiches into the next room where a card party was shown. The purpose of the display was to sell ginger ale to the hostess by the box so that it would be in readiness for any function in the home. We made 25,000 displays which were distributed all over the United States.

"Or take snap fasteners, sold in notion and ten-cent stores. You couldn't get a dealer to devote a window to such a minor article. To get snap fasteners into store windows, therefore, we originated a home sewing week and induced Woolworth's to display yarn, thread, needles, pins, scissors, and, of course, our Woolco snap fasteners. This is what we call co-operative window displays.

"With Yale locks we made a 'Guardian of the Nation's Health' display, illustrating how 24 billion dollars in the nation's banks are guarded by Yale locks. The display was of three dimensions, the door of the vault protruding in front, the opening in the vault cut out, and a receding plane illustrating Wall Street in the back. An arrangement was made for electric lighting to illuminate the back section. More than 500 banks wrote in to Yale and to our company asking if they could get such a display for use in their own windows.

"GLUE is another item so small that no dealer would want to feature it in a window. To overcome this obstacle when we planned a campaign for the Russia Cement Company, we got out a book called "LePaging." In this book there were about a hundred illustrations showing how beautiful, useful and ornamental things could be made with LePage's glue. Our window display illustrating a number of things that could be made with glue created a desire for the book, which in turn created a desire for the glue.

"As every advertising man knows, the attention-getting value in any given device is multipled many times if you can impart motion to it. The manner in which we displayed the Westinghouse electric fan illustrates the application of the principle. We had a cardboard sailboat with an actual canvas sail, the whole display being 30 inches wide by 44 inches high. In back of the boat an arrangement was provided to hold a small electric fan. With the current turned on, the fan vibrated the sail, adding motion at a cost that was trifling. The suggestion of cool ocean breezes was so strong that the display met with unusual success."

By the constant exercise of ingenuity Mr. Einson has built up the largest lithographic plant in the United States which devotes its entire facilities to window display work. Of the details of that we need not speak, of the force of "cardboard engineers" who must pay as much heed to stresses and strains as any bridge builder, of the largest camera lens in the world, of the more than 200 employees constantly at work for devices for some of the nation's largest advertisers. It is enough to say that this whole business depends for its continued prosperity upon its ability to furnish new ideas.

Unearthing History at Ur

How Two Great Institutions, One American, One British, Are Bringing to Light the Evidences of a Dim and Distant Past in Mesopotamia

By LÉON LEGRAIN, D.D., D.S.
Curator of the Babylonian Section, Museum of Pennsylvania University

NO one going around the world should miss stopping at Ur of the Chaldees to visit the native city of Abraham. Large excavations have been carried on there for six years by the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania. Wonderful results have been achieved. Not only the temple of the Moon God worshiped at Ur, and part of the city, streets and houses as they existed one or two hundred years before Abraham, have been recovered, but deeper levels have been exposed and the tombs of kings who reigned 1000 years earlier have been found, so rich in gold, silver and precious stones, with such a wealth of beautiful objects, that they throw a new light on the oldest, and until now unknown, culture of about 3500 B.C.

UR JUNCTION is on the railway from Basra to Baghdad for travelers going from India to Palestine over the Persian Gulf and the Syrian desert. The branch line has its terminal at Nasiriyah on the Euphrates, a small city of 8000 inhabitants, 12 miles away from the station and refreshingly cool with its palm groves and vegetable gardens on the muddy banks of the ancient river.

On the other side of the station in the opposite direction begins the immense Syrian desert and, a mile and a half away, slowly rising from the desert, are visible the low lines of the mud hills which mark the place of ancient Ur, still dominated towards the north by its solid brick tower, the oldest skyscraper of the world.

The director of the Expedition is Mr. C. Leonard Woolley, representing the two museums which in 1922 decided to unite their efforts. He is one of the best archeologists in the field, with over 20 years' experience in Nubia, at Carchemish on the Euphrates, in Italy, and in England. With the help of an architect, a reader of the cuneiform texts, an assistant for archeology, and a force of one to two hundred native Arabs from the villages along the Euphrates, he has been able to excavate whole tracts of the site continuously and on a large scale.

THE Expedition, which the first month lived under canvas and was attacked and plundered, has now a regular house. It is built with ancient bricks found in the ruins, the youngest bearing the name of Nebuchadnezzar or of King Nabonidus, the father of Balthazar. The mortar is mud, and the roof is mud on reed matting supported by rafters. The baked bricks being an exception are reserved for the better buildings; the adobes, or mud bricks, dried in the sun, form the main building material used in the Expedition's house.

In a country void of stone, all this matter of mud on mud will go far to explain how ancient cities came to be buried under 10 to 30 feet or more of mud. The disintegrated upper part buries the lower. When the whole is levelled it will form a welcome terrace for the next builder.

IN B.C. 2300, Ur—before Babylon and Baghdad—was the capital of Mesopotamia for over a century. Five kings in succession worked for the honor of the Moon God and the beauty of his temple. The main buildings visible on the surface are due to them or were restored by their successors. Among those successors the most famous are the kings of Erech and Larsa, about B.C. 2100—shortly before the days of Abraham—who restored the city ruined by the Elamites; next is King Kurigalzu of Babylon who, about B.C. 1400, tried to repair the damage done by the Amorites.

Last are the Chaldean kings Nebuchadnezzar and Nabonidus, who after the ruin of Nineveh endeavored to rebuild splendidly the shrines of an independent South.

The excavation has been in the main

THE DIRECTOR

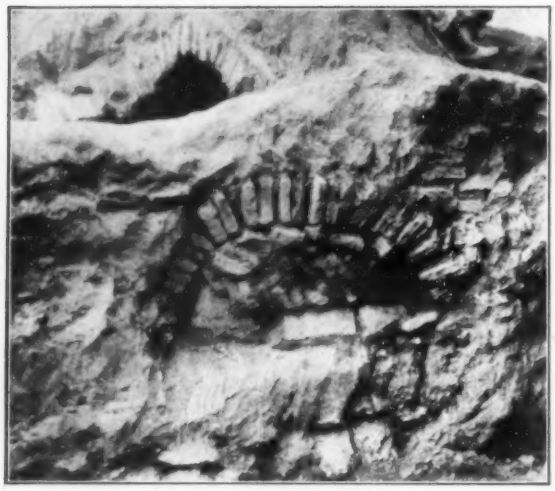
Mr. C. Leonard Woolley, photographed while examining a tablet excavated on the site of Ur of the Chaldees

◄ RAILWAY AT UR

To find a modern railway at Ur of the Chaldees, and to hear a steam locomotive chugging into the environs of the ancient city, gives one an odd sensation, almost of humor

▼EXPEDITION HOUSE

Suitable quarters for residence, storage and work are a requisite on any well-conducted expedition. This structure was built of second-hand bricks made thousands of years ago



THE OLDEST KNOWN ARCH

A doorway of the King's tomb, with masonry blocking. Heretofore an arch at Nippur was the oldest known. This one at Ur dates to the fourth millenium B.C.

limited in depth to the level of B.C. 2300. Below that level are buried ancient relics of earlier buildings and many feet of accumulated evidences of human habitation before one reaches the virgin soil. In the prehistoric cemetery, the excavation of a large area 30 feet below the level of B.C. 2300, has revealed the rich tombs of kings of Ur in B.C. 3500.

THE Moon God's temple is not a self-contained unit like the temples of Egypt and Greece. To a different conception of his deity is due the different plan of that deity's house. For the inhabitants of Ur, the Moon God is a king, the lord of the city, and he controls it very much like the temporal ruler, with stewards to manage his estate. Lists of functionaries are preserved which have a curiously familiar aspect. There is a high priest and his satellites; also a treasurer, a minister of war, of justice, of agriculture and housing, a controller of the household, a master of the harem, and directors of live stock, dairy work, fishing, and donkey transport. All these carried on their duties in the temple precincts; and so the temple is not a single building but a huge complex which is at once temple and palace, government offices, stores, and factories.

GOLD WIG

King Mes-kalam-dug wore this headdress which shows expert skill

At Ur this complex of buildings covered an area some 400 yards long by 200 yards wide, surrounded by a heavy wall. In the west corner of the enclosure was a raised platform also defended by walls whereon rose the brick tower called a "ziggurat" by the old Babylonians, and below the ziggurat stood the private particular house of the god. Compared to a medieval monastery or castle, the tower on its platform represents the keep and the walled temple enclosure the outer court of the castle. On three sides the ground sloped downwards from the base of the tower. A great courtyard extended in front of the northeast side of the tower. Its floor lay three yards below the foundations of the ziggurat. Clearly the stage tower was built upon one or more terraces which raised its lowest story above the surrounding plain.

If the excavation is continued for several years it will be possible to know more about Ur than about any other site in Mesopotamia. Let us, pilgrims of the Moon, enter the sacred enclosure through the southeast gate facing the great tower.

The *enciente* wall which divides the sacred city from the more profane Ur, has a total width of nearly 40 feet and consists of two parallel walls of mud brick connected by cross walls forming intramural chambers. Through another gate we enter the large courtyard at the foot of the tower. The narrow chambers around the three sides of the courtyard are store rooms and those flanking the main gate may be suites of apartments assigned to the priests of the Moon God. The wall of the court below the ziggurat is of whitewashed semi-columns which give elevation to the building.

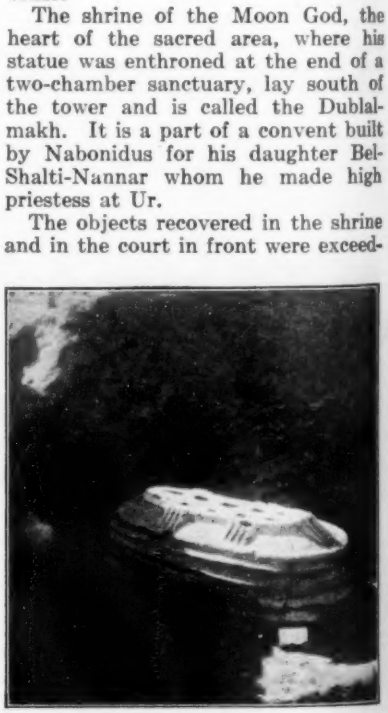
FROM the courtyard, the tower can be seen as a whole with its three staircases meeting on the first landing or second story. Into that great courtyard, as in the modern khan of the Near East, the countrymen would drive their donkeys laden with sacks of corn, piled baskets of cheese and butter, oil jars, bundles of skins, loads of wool, boxes of precious stones and metals, and would also drive the live animals destined for offering and sacrifice. Receipts for country products, also for hides, for gold and silver from the jewelers, for copper from the smiths, along with a furnace for melting metals, jars full of scraps, and ingots of some standard weight have been found in the registrar's office next to the court.

The great tower of the Moon God, his throne and habitation close to heaven, is of solid brick construction on a rectangular plan, 200 by 130 feet and about 56 feet high to the level of the upper stage. The first story was built by King Ur-Nammu about B.C. 2300. The upper stories and the shrine are an addition of Nabonidus about B.C. 500. The tower has four stages with diminishing area and supports a small empty shrine of blue glazed bricks. The top story is made of red bricks covered with red plaster. Farther down, the ziggurat is black, covered with a coat of bitumen, resting below again on the whitewashed columned walls of the court.

THREE staircases of 100 steps each lead to the first stage of the ziggurat, through a monumental gate to the upper stories and to the shrine. The solid core is of mud bricks, the facing of burnt bricks set in bitumen. The walls have an inward batter, and are relieved by shallow buttresses and pierced with weeper holes to drain the core. The empty shrine on the top was the abode of the high priestess who here awaited through dreams and observation of the heavens the visitation of her spouse, the Moon God. Simple as is the ziggurat scheme, its development results in a monument whose architectural merit is of no mean order.

The shrine of the Moon God, the heart of the sacred area, where his statue was enthroned at the end of a two-chamber sanctuary, lay south of the tower and is called the Dublal-makh. It is a part of a convent built by Nabonidus for his daughter Bel-Shalti-Nannar whom he made high priestess at Ur.

The objects recovered in the shrine and in the court in front were exceed-



CLAY COFFIN

The dead were buried under the floor of the dwelling. Sanitary science was unknown

ingly numerous and important. The greatest of all, the stela of King Ur-Nammu, the builder of the ziggurat, was a limestone slab nine feet high by five feet wide and about one foot thick, carved on both sides with five registers of reliefs, showing the king worshiping his god and receiving the mission to build his house. That important historical document and magnificent example of the art of the time is now the property of the Museum of the University of Pennsylvania.

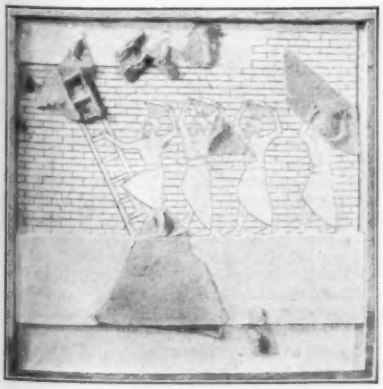
The private palace of the high priestess bordered the shrine towards the west and the treasury house towards the east. The palace of the priestess, also a shrine of the Moon Goddess, is built on a rectangular plan with fortified gates north and south. Shrines, stores, apartments, were grouped inside around three courts.

The southern court is the most perfect sacred place of that early period three centuries before Abraham. The bronze gates are gone, but the door sockets are still in position with the name of the founder clearly engraved. The shrine proper was a double room at the end of the court. Two brick altars were erected in the middle of the court.

ON them was piled the scented wood of morning and evening sacrifice. On them were burnt the bodies of yearling lambs and kids. The blood was poured on the threshold. The statue of the goddess was raised on a brick altar at the end of the second room.

Sacred vessels were stored in side rooms; the most precious ones of gold and silver have disappeared, but the stone vases were found broken and scattered on the pavement. The inscribed fragments prove that they were votive offerings to the great goddess of Ur.

This building is admirable for its symmetry, spaciousness and dignified harmony, and would do credit to any period of architecture. One of its most interesting features is the great kitchen adjoining the shrine, which irresistibly recalls the scene described in the Old Testament where the sons of Eli send their servants to pick out of the pan, kettle, and caldron the flesh of the sacrifice before it was offered. The kitchen at Ur has two fire ranges, a well, a tank, an oven, millstones, and a sideboard for chopping meat.



BUILDING A TOWER

The stela depicts the construction of the brick tower. Lighter parts are restorations

THE SACRED AREA AT UR, FROM THE SOUTH

The ziggurat is the nucleus; around it were the numerous temples and the temple precinct containing government offices, stores, workshops and other structures

DOUBTFUL SANITATION

Drainpipes were placed under the floors. We are not far removed from such conditions

Leaving the sacred area by the western gate, the pilgrim would enter at once a thickly populated quarter of the city with narrow lanes between brick walls, which strangely resemble the crooked streets of a modern Arab city around the great courts and walls of the mosque. The real interest lies in the discovery that the well preserved town quarter dates from the time of Abraham or before.

ON the main level were unearthed streets and houses which throw a new and unexpected light on the social and domestic conditions of the period. Instead of a poor, single-storied, mud brick building, we find a different picture: burnt brick used freely; remarkably good bricklaying; a two-storied building, almost a counterpart in ground plan and elevation of the house of a well-to-do citizen of modern Baghdad. The streets are narrow and mud paved, as in every modern town of the Near East. The house opens directly on the street. The essential feature is a central courtyard surrounded by chambers which open on to it.

One door from the courtyard is that of the staircase going up to the second floor and to a wooden gallery on which the rooms would open. The same gallery exists in modern Arab houses, which strikingly preserve the old tradition of Ur.

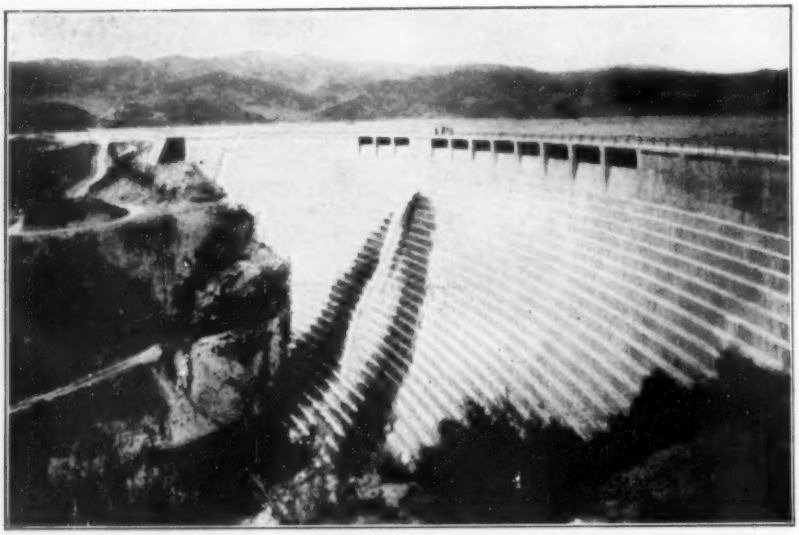
MANY graves were found below the floors in every house, and one special room served as a family chapel. In the southern part of the sacred area an old tradition seems to have reserved the ground for burial, close to the sacred place, under the shadow of the great tower and the protection of the Moon God. There were no remains of buildings on the surface but from the beginning the upper level yielded tombs dating from B.C. 2200. Below that level Mr. Woolley found three different cemeteries, the youngest one dated by inscribed gems of B.C. 2600, the oldest one going back to the grim old age of B.C. 3500.

But it is time to rest after our hurried journey. Like all visitors at Ur, we will climb again the hundred steps of the tower and from the summit gaze over the immensity of the desert. This morning it seems alive. Wave after wave, the flocks are passing, moving towards new pastures; black goats and sheep followed by their shepherds who walk like kings, their long crooks across their shoulders, their great mantles floating in the light air. Camels are driven by Bedouins on horseback. Is this a dream of 4000 years ago, the march of Abraham leaving Ur of the Chaldees?

At noon the wandering tribe will have passed and the desert will be silent. The wind sweeps unrestrained over the plain and the sand crumbles under our feet.

Why *THE*

Although the Collapse,



ST. FRANCIS DAM BEFORE THE DISASTER

Pronounced safe only one day previously, this great dam collapsed March 13th and flooded the valley below with a rushing wall of water, resulting in great loss of life and much damage

BETWEEN the hours of 12 and 1 o'clock the morning of March 13th, the St. Francis Dam of the Los Angeles aqueduct system gave way, releasing 12,000,000,000 gallons of water which swept a wide path of death and destruction from the mountains to the Pacific Ocean. In some places there must have been an 80-foot wall of rolling water. The roaring of the flood, reverberating back and forth against the sides of the canyon was the first warning to residents. It was a sound like thunder, survivors said.

St. Francis Dam was completed in May, 1926, by the Los Angeles Bureau of Water and Power under the personal direction of William Mullholland, chief engineer of the Los Angeles Bureau of Water and Power. The dam was a concrete curved gravity type and cost 1,300,000 dollars. The dimensions of the dam, as obtained from data compiled by the *Western Construction News*, were as follows: height above foundation, 205 feet; height above stream bed, 175 feet; crest length, 668 feet; thickness at the base, 175 feet; thickness at the top, 16 feet with a traversing roadway; and radius of slope curve, 492 feet. There was a spillway with 2400 second-feet capacity with an additional 1000 second-feet capacity through five outlets in the dam. The dam contained 137,000 cubic yards of concrete.

THE reservoir behind this dam had a capacity of 38,000 acre-feet of water, which was purely a reserve supply for domestic purposes, to be used in case of emergency. At the time of the break, the storage was sufficient to supply the city of Los Angeles with water for approximately two and one half months. The reservoir was the second largest in the municipal chain of storage basins, and was located about 15 miles up San Francisquito canyon from Saugus. Above it is San Francisquito power house Number 1, which has a capacity of approximately 60,000 horsepower and which still stands. Below was San Francisquito power house Number 2, which was swept away.

AT both sides of the standing center section there are two wide gaps, where the 12,000,000,000 gallons of unleashed water thundered through. The section still standing is perhaps a hundred feet in width. The concrete that filled the great gap on the right or westerly side of the dam was broken up and washed down with the great flow of water as it rushed down the canyon. Pieces of concrete as large as a bungalow were washed down the stream and deposited in the stream bed at distances ranging from one quarter to one half mile below the dam. The concrete that filled the gap on the left or easterly side of the dam broke up into four major pieces but none of the pieces were washed away. The breaks occurred apparently at construction joints.

Practically every engineer that has visited the dam since the collapse agrees that the westerly wing of the dam went out first, as the large pieces of concrete now lying downstream from one quarter to one half mile from the dam could have been carried this distance only under the full sweep of water when the reservoir was full. The left wing of the dam must have collapsed some time later at a time when so much of the water in the reservoir had escaped through the gap in the right side of the dam that the remainder did not have enough force to carry the pieces into which the east wing broke.

An Engineer Says:

"WHEN, during the early stages of the dam construction, the face of the westerly abutment was stripped of its earth overburden, there appeared a well-defined line of cleavage between the conglomerates and the shales.

"The Fault Map of the State of California, compiled from data assembled by the Seismological Society of America in cooperation with the Hydrographic Office, Navy Department, the United States Geological Survey, the Carnegie Institution of Washington, the University of California, and Stanford University, in 1922, shows a 'dead fault well located' along the axis of San Francisquito canyon passing directly through the dam site. It is more than probable that this fault is the cause of the broken condition of the formation upon which the dam rested.

"The structure may be described as a gravity section, mass concrete dam. This type is one of the oldest in use and has always been considered safe. The design contains many indeterminate stresses, but a sufficient factor of safety is provided for by the excess mass of concrete which lends stability by sheer weight. The safety of the design is, however, predicated upon the availability of proper natural abutments and foundation.

"It is the opinion of the writer that the dam failed because of improper foundation material under the abutments. With a full reservoir, the material forming the natural abutment became saturated with water, which, seeping in ever-increasing quantities, caused a loss of contact between the concrete structure and the natural formation. This left the ends of the dam unanchored and subject to the tremendous pressure of the impounded water, causing stresses for which the dam was not designed and which ended in failure."

The paragraphs above were quoted from a report made to the author by Harmon S. Bonte, Consulting Engineer and member of The American Society of Civil Engineers. His report is valuable because, during construction of the dam, he made three trips of inspection to the site at long intervals, and two more after it was completed and water was actually impounded.

The Editor.

St. Francis Dam Collapsed

Fault on Which the Dam Was Erected Contributed to Its Softness of Foundation Bed-rock Was Primary Cause

By CHARLES W. GEIGER

St. Francis dam was constructed on the San Francisquito fault, a geological feature known for a number of years and made the subject of publication illustrated by maps, chief among these being that published several years ago by the Seismological Society of America, which shows the major faults of California.

This statement, made March 22nd by Harry R. Johnson, consulting geologist of Los Angeles, speaking in San Francisco before the delegates to the convention of the American Association of Petroleum Geologists, created a profound impression, accompanied as it was by an analysis of the condition of the fault at that particular place.

Mr. Johnson prefaced his report by saying that the advisability of making it had been discussed with other delegates, and that it had been decided that such a public report was advisable in view of the fact that "the public mind had been deluged by the wildest assortment of theories as to the cause of the catastrophe."

A BRIEF extract of Mr. Johnson's report, which appeared in the *San Francisco Chronicle*, follows:

"The line of the fault was easy to trace. It extends from about four miles north of Saugus to a point about seven miles northeast and connects with an eastern section of the fault which intercepts the San Andreas fault. He, (Mr. Johnson), was explicit in explaining that, while the San Andreas fault is what is known as a live fault, the San Francisquito fault is a 'dead fault,' as far as is known.

"The general character of the bed-rock, he said, is schist, black gouge, and red conglomerate. The southeast end of the dam abutted against the schist wall of the canyon, which was of ancient origin, and this mass had faulted against a younger conglomerate.

"The plane of dislocation between this ancient schist and the younger conglomerates was directly beneath the right wing of the dam. Any fault or fracture is a line of weakness.

"Mr. Johnson told of having examined a great block of concrete (60 feet by 60 feet by 70 feet, the foundation surface that originally rested on the bed-rock being exposed and easily examined) that had been washed some distance from the dam site. On this block, he said, he found schist, a part of the original bed-rock, and also black gouge from the fault as well as red conglomerate. There was evidence of extreme shattering; sandstone and conglomerate formed a mass of faulted blocks, so jumbled that the continuity of the bedding was nearly destroyed.

"Fault planes are good water carriers and any fracture or fault is not only a line of weakness, but a channel for percolating waters in case they should find entrance.

"MR. JOHNSON said he had found no evidence of general earth movement in recent times, but that such evidence might have been lost. He did, however, find evidence of slides, either before, during, or after the dam went out. He did not establish which. He said he was not prepared to discuss the slides.

"Mr. Johnson said he believed the dam to have been a 'competent structure,' but the fact that it went out was a lesson pointing to the advisability of consulting geologists regarding selection of dam sites rather than to leave such selection to engineers.

"He suggested to the delegates that when they return to their homes they should work for the appointment of commissions of competent geologists to inspect present and future sites for dams. Too many times the advice of geologists is ignored and sites are established by engineers without proper knowledge of conditions that are vital to the maximum safety factor.

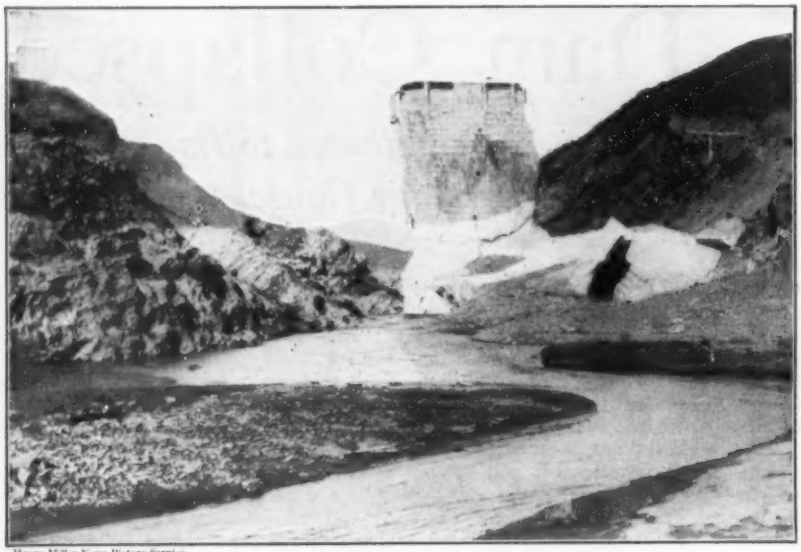
"After his talk, Mr. Johnson said that the fact that a dam is built on a dead fault was not to be taken as indicating lack of safety. 'If no dam in California were built on a dead fault there are many dams which would not have been built.'

"He declined to express his opinion of the advisability of having constructed the St. Francis Dam on the site it occupied, but acknowledged that it was 'advisable when selecting a site, whether or not that site was on a fault, to take into consideration the geological significance of the bed-rock structure.'"

THE plane of the San Francisquito fault dips at variable but definite angles toward the northwest and is clearly visible as a gouge-filled line separating the gray schist to the southeast from the reddish conglomerates and sandstones to the northwest. This gouge is a grayish to blackish clay material which occupies the plane of movement between the schist on the one side and the younger conglomerates and sandstones on the other. It is nothing more or less than a very finely divided and crushed material resulting from the intense movement along the fault and when this gouge is wet it is as slick as soap and fragments immersed in water immediately begin to settle

FAULT LINE

Within the dotted line may be seen the junction—known as a fault—of the schist (above) and the conglomerates and sandstones (below the junction). The failure was due, in part, to this fault



Henry Miller News Picture Service

LIKE A MONSTROUS HEADSTONE

The central section of the dam, which remained standing firmly in place after the break. Compare with size of men (about as large as pinpoints) standing on left promontory

down into an "ooze", or clayey mud.

The topography of the canyon wall on the right side was that of a "hog-back," a long spur of land projecting out. Extending from the end of the right wing back over this "hog-back" was a low-gravity concrete wall several hundred feet in length and from 30 to 40 feet in height according to terrain.

Many theories have been advanced in an effort to explain just how the left wing of the dam was destroyed. The theory held by a number of engineers is that after the breaking of the right wing, the great torrent of water flowed out through this large gap and whirled around and around in eddies below the left wing of the dam, until the foundation of the left wing was washed away, permitting the concrete wing to collapse into four major pieces which simply toppled over and did not wash downstream, because there was not sufficient velocity or volume of water at the time of collapse to carry them. Engineers who have examined the wreckage practically all agree that the concrete apparently was all of good quality.

FRAGMENTS

An immense section from the left wing that fell in front of standing section and did not go downstream

CALIFORNIA State Engineer Edward Hyatt recently issued a statement in which he declared that "No one is justified, either openly or by suggestion, in attempting to fix responsibility at this time for the disaster." He issued the statement to clear up what he said was erroneous use and interpretation of his prior statement.

"MY statement that the dam was constructed by the Light and Water Department of the City of Los Angeles," he said, "has apparently been misconstrued to mean that responsibility for the failure of the dam lay at the door of that city. At no time did I intend to suggest that the dam was either improperly designed or improperly constructed. Neither did I mean to convey the thought, nor do I think that responsibility for the collapse of the structure can be placed anywhere at this time. The cause of the failure is yet to be determined. It can only be ascertained by a most careful study of conditions at the dam site. In this study both the best engineering and geological talent should join.

"Any statement made now as to the cause of the failure of the structure is at best but a theory. Until the evidence is all in, the public should avoid forming any conclusions as to where responsibility rests.

"There is evidence at the dam and reservoir of extensive landslides. Did these landslides occasion the collapse of the structure, or did they occur after the dam had gone out? These questions cannot be answered with the information now available.

"Again, the theory has been advanced that the collapse of the dam was due to an earthquake fault. At the present time it is impossible to check this theory. The correctness of this explanation must await an investigation by expert geologists at the dam site itself.

"A THIRD theory is that the dam went out because of the failure of foundation. What could have caused such a failure? It could hardly have been due to faulty concrete, for the standing center section and broken fragments are sufficiently exposed to enable the concrete to be examined. This concrete shows no evidence of weakness or deterioration. Did the nature of the foundation upon which the dam rested change after its construction through the soaking effect of water coming from the reservoir above? If so, could such a result have been anticipated? These questions yet await evidence upon which an answer can be based. Were there other causes for foundation failure if such occurred? No one can answer this question as yet.

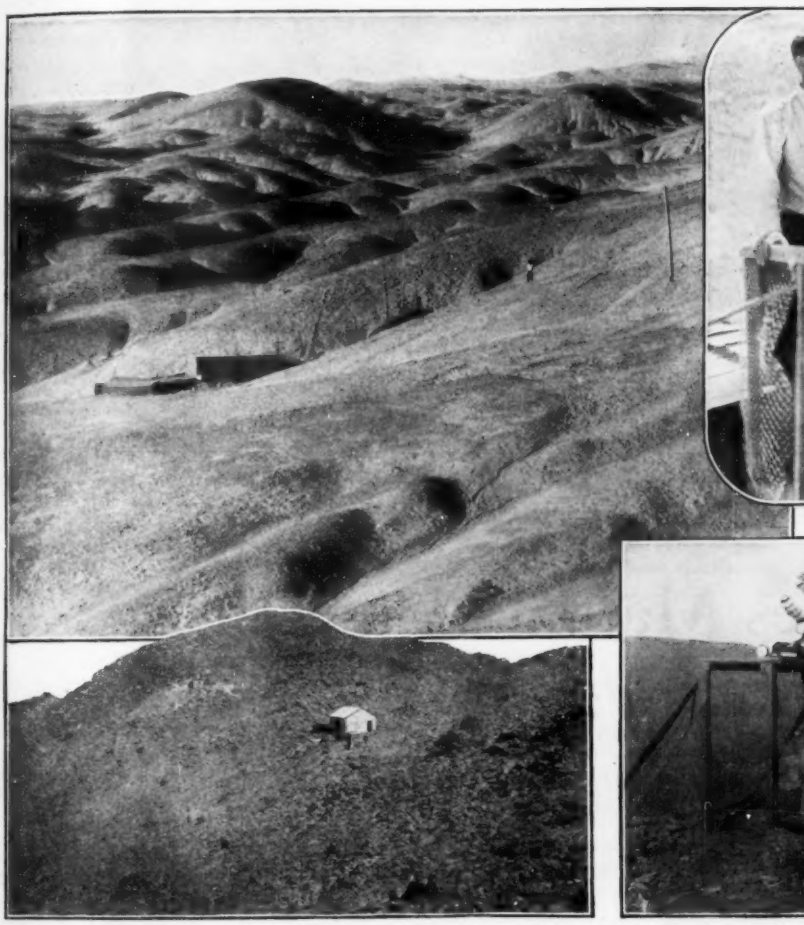
"All these things have yet to be determined. In advance of a complete study and investigation conducted by engineers and geologists at the site of the dam and reservoir, certainly no one is justified, either openly or by suggestion, in attempting to fix responsibility for the calamity."

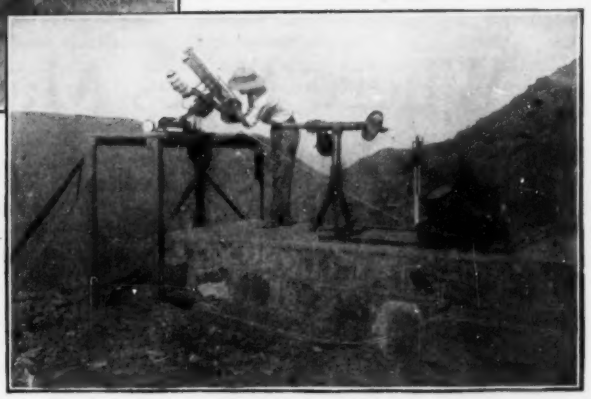
The obvious conclusion of all this is that, in building dams whether they be of the gravity or concrete arch type, the geogolist may be more important than the engineer.

FACE OF STANDING SECTION

This shows character of the rock foundation on which the right wing was constructed

Robinson Crusoes of Science





HARDSHIP and risk of life endured for the sake of science are not altogether uncommon, but even more worthy of acclaim, although less spectacular, are the uneventful lives voluntarily assumed by many of its faithful votaries who never publicly lay claim to credit. What monk, for example, could ever subject himself to a voluntary exile more monotonous and dull than the little party of three whose photograph, shown in the upper right hand corner, was taken in the tiny South American "home" visible in the picture at the left; or the scientists in the lower picture who work permanently at the lonesome spot in Africa shown opposite?

The first pair of photographs were taken near Calama in the arid nitrate deserts of Chile where observer H. B. Freeman of the Solar Observatory of the Smithsonian Institution, Mrs. Freeman, and Assistant E. E. Warner have just put in three years of exile in order to make daily measurements of the Sun's radiation. This is being done with a view to collecting proof of variation and determining the amount so as to provide data from which to learn the influence of this variation, particularly on the Earth's weather.

Not a tree, not a shrub nor even a blade of grass grows at Calama. In their whole three years there the party saw exactly one wild animal, a fox. Drinking water was hauled 12 miles. Fresh food other than meat was a rarity and chronic indigestion soon resulted for all. Day temperatures were 80 degrees; night temperatures near freezing or below. For social companionship there was a Scottish family 12 miles distant and a few English and American people still farther. The Smithsonian Institution provided a radio but it proved useless, for the static, even at its minimum, sounded like a hailstorm.

THE lower pictures show another Smithsonian Institution observatory established for the same purpose, at Mt. Brukkaros, southwest Africa. Here Observer William H. Hoover, Mrs. Hoover, their infant daughter, Betty Jean, and Assistant Fred Greeley, have made their home for the past two years on a mountain 2000 feet above the surrounding plateau. Their first residence was in a cave, but is now in the house that shows in the foreground. Until the infrequent rains came to fill their reservoirs, their only water was carried up from the crater 1000 feet below. The nearest settlement is seven miles away and contains one German missionary and his wife, one Jewish storekeeper and 300 Hottentots; but Keetmanshoop, 62 miles distant, contains 900 white population. For amusement and "society" the scientists at Brukkaros have a cow, a dog, a cat and a phonograph.

In the lower right-hand photograph the observer at Brukkaros is adjusting the silver disk pyroheliometer invented by Dr. C. G. Abbott, Secretary of the Smithsonian Institution. This instrument, with other apparatus, determines accurately the Sun's output of radiation. It is Dr. Abbott's theory that the Sun is a variable star and that the variations in its radiation affect the weather. If this theory is established, weather forecasting will be facilitated. Hence the reason for the Smithsonian Institution's several solar observatories, each situated where the air is clear.

THE SOUTH AMERICAN LAKE WHERE PART OF THE RESEARCH WAS DONE

To exclude thunderstorms as a possible source of the cosmic rays, the lake used must have high, close walls. Lake Miguilla in the high Andes of Bolivia, 700 feet wide, answered this description. Altitude 15,000 feet; depth 175 feet

Where Does Matter Come From?

The Recent Research of Millikan Points to a Hitherto Unknown Creative Process in Nature

By ERNEST G. LINDER
Instructor in Physics at the California Institute at Pasadena

THAT creation is continuous; that this is a changing, dynamic and constantly evolving world, instead of a disintegrating one, is indicated by new discoveries of Dr. Robert A. Millikan, one of America's foremost scientists, Nobel prize winner, and director of the Norman Bridge Laboratory of the California Institute.

In view of the newly-discovered facts brought to light by recent and more precise measurements of cosmic rays, it seems probable that ordinary matter is being created in the stars, the nebulae, or in the depths of space. Or, as Dr. Millikan himself puts it, "The heretofore mysterious cosmic rays, which unceasingly shoot through space in all directions, are announcements sent through the ether of the birth of the elements."

THE long series of remarkable experiments culminating in this new discovery began in 1921 when Dr. Millikan and his assistant, Dr. I. S. Bowen, went to Kelley Field, Texas, where they fastened self-recording instruments to sounding balloons and sent them nine tenths of the way to the top of the earth's atmosphere or about ten miles.

Since then Dr. Millikan and Dr. G. Harvey Cameron have made experiments under many different conditions. They have sunk their instruments into the waters of snow-fed lakes in the mountains of California; they have performed experiments in the snows on Pikes Peak; they have worked in the high Andes of Bolivia.

Throughout these investigations they have constantly improved their instruments and made measurements that became more and more precise, until now it seems that a point has been reached where the mystery of the origin of the rays is about to be solved.

Dr. Millikan's present theory, which he says must not, however, be accepted as fact until it has been proved by further tests, is that the rays are generated somewhere in the heavens when primordial positive and negative electrons unite to form helium atoms and other light atoms such as oxygen, silicon, magnesium, and iron.

Courtesy of Dr. Cameron

PROFESSOR MILLIKAN AND DR. CAMERON

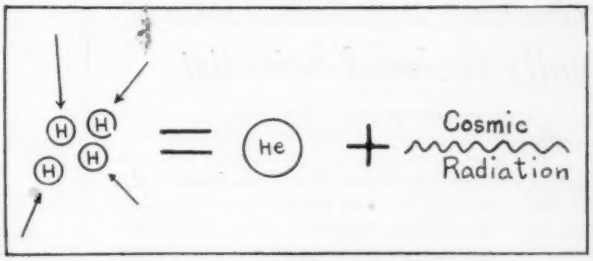
Professor Millikan is Director of the Physics Laboratory at the California Institute of Technology. He is shown assembling an electroscope shielded by lead plates

IN order to understand just how this happens, let us take the birth of helium as an example. An atom of helium is formed by the union of four atoms of the lighter element, hydrogen. Hydrogen has an atomic weight of 1.00778. We would therefore expect an atom of helium to weigh exactly four times this amount, or 4.03112. Actually, however, the atomic weight of helium is found to be 4.00054, which is less than the weight of four hydrogens. There is a loss of .03058. In other words, that much matter has disappeared.

Helium is not unique in this

respect. A similar loss of mass occurs in all cases where a heavier element is formed by the union of a number of hydrogen atoms.

This is no new fact. Physicists have known about it for years, and the greatest of them all, Albert Einstein, has formulated a theory to explain the phenomenon. According to this theory of Einstein's, the matter which disappears turns into radiation. And now Dr. Millikan comes forward with the assertion that it is this very radiation, produced at the birth of the elements, which makes up the cosmic rays. The salient, quantitative point of Millikan's discovery is that the penetrating power of the rays he measured agrees to within a few percent with that predicted by Einstein's theory.



ONE SOURCE OF COSMIC RADIATION

When four hydrogen atoms unite to form one helium atom, a certain amount of matter disappears to reappear as energy—cosmic radiation

THIS means that it is very probable that somewhere in space, or in the stars or the nebulae, complex elements are being built up from hydrogen, and cosmic rays are being generated in the process. The diagram on this page shows graphically four hydrogen atoms coming together to form one helium atom and the corresponding amount of cosmic radiation.

The rays that Millikan and his associates have been measuring are a complex mixture of many different kinds of radiation, since they are produced by the birth of many different kinds of elements. Four principal bands, however, predominate. There are, first, those rays due to the union of hydrogen to form helium, as described above; second, a group due to a similar combination of hydrogen to form oxygen and nitrogen; third, those due to a similar creation of silicon and magnesium; and fourth, those produced when the atom of iron is born.

These elements are, strikingly enough, the most abundant in the universe. Hydrogen and helium make up a large part of the great nebulae, while the four substances, oxygen, magnesium, silicon, and iron, are the most abundant elements found in meteorites and in the earth of which they make up about 95 percent of the total mass. Hence it is not surprising that the chief components of the cosmic ray correspond to the birth of these chief elements; it is exactly what would be expected if these substances were being continuously formed somewhere in the heavens.

"FURTHER qualitative support," says Dr. Millikan, "is derived from the fact that so far as we can now see there are no sort of nuclear changes which could take place powerful enough to produce the observed cosmic rays except those herewith suggested." Cosmic rays are in fact the most powerful known to science. They will penetrate 200 feet of water or 17 feet of lead, while the most penetrative X-rays are stopped by a half inch of the latter substance. Their wavelength is so small that it would require 1,300,000,000,000 of them to equal one inch.

Cosmic rays have a frequency of approximately 100,000,000 times that of ordinary light. A still better idea of how they compare with more common types of radiation may be obtained from the following table which gives the frequencies in kilocycles of some well-known rays.

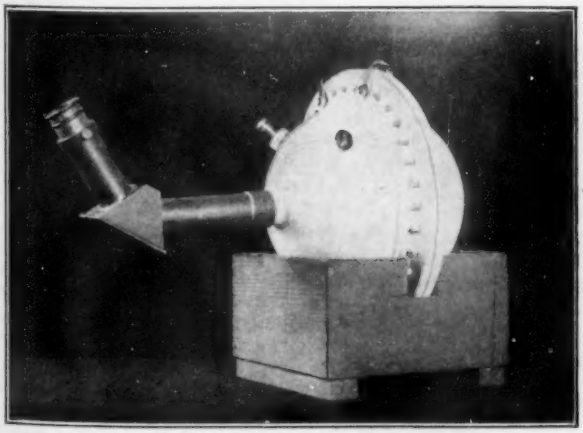
Radio	600
Ordinary light	600,000,000,000
X rays	3,000,000,000,000,000
Cosmic rays	15,000,000,000,000,000,000

CALCULATION shows that the power required to produce such radiation in the laboratory is at present far beyond the range of possibility. If we could make a 60,000,000-volt X-ray tube it might generate a few of the cosmic variety. It has been shown that even a lightning discharge does not produce them.

Dr. Millikan has still another reason for believing that cosmic rays are the birth announcements of the elements. "We have known for thirty years," he says, "that in radioactive processes the heavier atoms are disintegrating into lighter ones. It is therefore to be expected that somewhere in the universe the building up process is going on to replace the tearing down process represented by radioactivity."

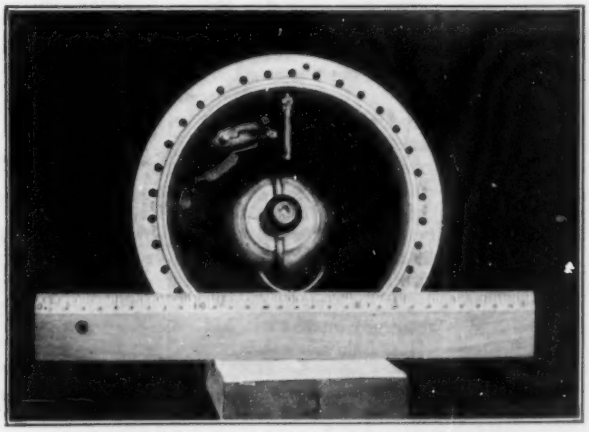
In the principal radioactive transformations the heaviest of the elements, uranium, disintegrates slowly, its complex atom breaking up into a less complex one. This, in turn, breaks up again, and the resulting product still again, and so on, so that we get a so-called radioactive series. This is clearly a one-way process. It is like water seeking a lower level by going over a series of falls.

If there were not some sort of a counteractive process to renew the supply at the top the falls would eventually go dry. The situation is exactly the same with matter. But up to the present no evidence of a process counteracting radioactive decay has been found.



PROFESSOR MILLIKAN'S NEWEST ELECTROSCOPE

This is ten times as sensitive as the older ones. This is the instrument which was sunk deep in the Californian lakes



INTERIOR OF THE SAME ELECTROSCOPE

The cosmic rays discharge a charged electroscope at a rate depending on their access to it. They penetrated 190 feet of water

Paintings *that* Shine *in the* Dark

A New and Fascinating Amateur Hobby for the Artistically Inclined Scientist

By L. A. HUGUEMONT
General Electric Company

WHEN one considers that the universe, as the eye beholds it, is colored in thousands of various shades and hues, one cannot fail to appreciate the skill of our painters who, with comparatively few pigments, are capable of creating for us the illusion of sunshine, bright skies and sparkling water—in short, a landscape which in reality has several thousand times greater color contrasts than actually exist.

About three years ago, the well known Viennese scientist, Dr. F. Blau, described a method of painting whereby a much wider color range could be obtained. His scheme involved the use of a highly-polished, black, lacquered surface or a black glass plate on which the various tints and shades, from white to dark gray, could be applied, the finished painting itself being covered by a glass plate. In this manner Dr. Blau widened the range downwards; his black became blacker, since he had eliminated the diffused reflection of ordinary black paint. Incidentally, his whites appeared much brighter by contrast, but they were still incapable of rendering sunbeams or reflections with all the desired naturalness.

IN an effort to improve this color range still more, it occurred to the writer to experiment with the phosphorescent sulfides that are now on the market, such as the zinc, calcium and cadmium sulfides. As is well known, these substances phosphoresce in the dark after they have been excited by ordinary light.

To begin with the experimenter should not embark upon too ambitious a program; the use of a great many hues would require the skill of a consummate artist. For this reason, the beginner will do well to limit himself to the red-orange, yellow, green and blue zinc sulfide (ZnS), and the bluish-purple calcium sulfide (CaS) which at present can be easily obtained on the market.

As Professor H. A. Taylor explained in his article, "New Lights for Old," in the SCIENTIFIC AMERICAN for November, 1927, the intensity of the phosphorescence, as well as the color, depends on a very minute admixture of an impurity with the zinc sulfide. It may be added that they depend also on the time and temperature variations in the preparation. The foreign substances may be copper, manganese, magnesium, cadmium, and so on.

Yellow and green are the easiest colors obtainable in the zinc sulfide group. The so-called blue phosphorescent zinc sulfide, as generally obtained, is not as satisfactory, for it is still of a greenish hue. However, a thorough mixing with CaS will improve its color. Likewise, the commercial red phosphorescent zinc sulfide is rather disappointing. It is very evanescent and is more like a deep orange, but in this case also improvements are possible, as will be shown later.

A VERY important paint on the palette of the phosphorescence artist is calcium sulfide. When used alone it emits a bluish-purple color which, after about five minutes, becomes pale lavender, and after 15 minutes, whitish. The only trouble with CaS is the possibility of its decomposition. While all the zinc sulfides may be easily mixed with water or any varnish, CaS is exceedingly sensitive to acidity. When mixed in a thin solution of gum arabic and water, (the ordinary way of preparing zinc sulfides), CaS will for a while phosphoresce very vividly, but its brilliancy will not last unless the atmosphere be pure and dry.

Ordinary varnish will invariably spoil the best CaS. The writer experimented with several vehicles and found that

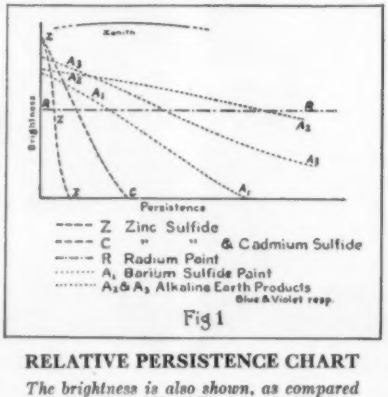


Fig 1

RELATIVE PERSISTENCE CHART

The brightness is also shown, as compared with that of the full moon at zenith

A PHOSPHORESCENT PAINTING

Unfortunately it is impossible to reproduce the paintings in their true (phosphorescent) state. Imagine this in spooky green and red

pyroxalin, with so-called Number 5 thinner, when used with certain precautions, gives fair results.

CaS with green ZnS gives a fair white; with red ZnS it will give a beautiful pink lavender. The brown, olive, and gray tints, without which no shading can be accomplished, can be obtained by adding non-acid white paint such as is used by artists (permalba, zinc white or the like). The dark parts of the painting can be made with permalba alone.

The whole painting procedure resembles the art of china painting, in which the artist uses colors of the most incongruous shades which are entirely changed by the process of firing. In the present case the artist uses paints that appear white, cream or pale yellow under ordinary light but which, in darkness, radiate in vivid colors.

THE sulfides and vehicles just mentioned will enable any amateur in this novel art to produce very acceptable paintings from the beginning. However, those who wish to obtain better reds and blues will be glad to hear that other substances have been found which meet all the requirements as to hue, brilliancy and persistence.

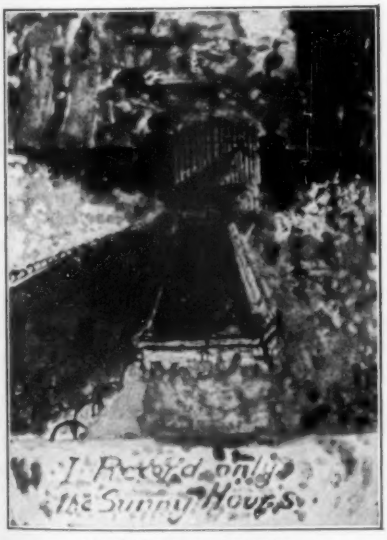
A French company is placing on the market phosphorescent paints belonging to the alkaline-earth sulfide group. These are quite excellent and are to be preferred to the zinc sulfides whenever the duration of the excitation need not be considered, for while the time for exciting the zinc sulfides is of the order of seconds, that for exciting the alkaline-earth sulfides is of the order of hours. On the other hand the persistence of these latter paints makes them very valuable. Their red lasts 15 to 20 minutes while the red-orange of

ZnS will last but three minutes at most.

The alkaline-earth sulfides also are much cheaper than the zinc sulfides. For instance, violet and blue retailed last year in Paris for about 130 francs and 170 francs per kilogram, respectively, (roughly $2.60 and $3.40 per pound). The red, orange, and green sulfides retailed for about 650 francs per kilogram, (roughly 13 dollars per pound). Compared with these prices the zinc sulfides were rather expensive, for they were sold at retail for about 800 to 850 francs per kilogram, (roughly 17 dollars per pound).

THE accompanying graph, Figure 1, by M. Ronneaux, a noted French expert on luminescence, illustrates the persistence and brightness of various phosphorescent materials, the brightness being compared to that of the full moon at its zenith.

This discussion of the paints for the palette of the phosphorescence artist would not be complete without a mention of Hammer's method (United States Patent number 12,812, now expired). Two months ago Mr. Hammer called the writer's attention to his process of obtaining persistent phosphorescent paints, a process which seems remarkable because of its simplicity. It consists in combining with some phosphorescent material, preferably calcium sulfide, certain fluorescent



ANOTHER PAINTING

One of these weird creations by the author now glows at night by the editor's bedside

substances of various natures and colors. Says Mr. Hammer in the above-mentioned patent:

"As practical examples of the application of my invention I mention that eosin, triturated and dissolved in an appropriate vehicle, and then mixed with calcium sulfide, causes a pink luminescence entirely different from that of the calcium salt. A preferred way is to triturate the eosin and dissolve it in the vehicle, and then to mix with the latter the powdered calcium sulfide, with precaution hereafter described, thoroughly incorporating them into a smooth paint capable of application with a brush or otherwise.

"To obtain colors in the red end of the spectrum, I employ as a fluorescent rhodamin, thus obtaining the most brilliant scarlets, reds and magentas; the rhodamin may be dissolved in alcohol or ammonia and then ground or otherwise thoroughly incorporated with calcium sulfide or other phosphorescent material after which the resulting mixture may be mixed with a varnish or other drying oil. The tint produced will depend upon the amount of the fluorescent coloring matter employed.

"I HAVE also produced a white phosphorescence practically free from traces of the usual green-blue, and which is, as far as I am aware, the first production of this effect. This is obtained by combining a mixture of phosphorescent zinc and calcium sulfide with alcohol, or with a trace of tincture of stramonium or uranin in alcohol, and making a paint with oil as hereafter described.

"A fine yellow or orange color in different shades may be produced by combination of uranin, dissolved with zinc sulfide.

"The blues may be produced from resorcin with calcium or zinc sulfides, resorcin blue being one of the most fluorescent substances with which I am acquainted; very intense blues may be produced by relatively small amounts of the dye."

This strange effect, whereby the fluorescent material changes the phosphorescent color CaS, is probably due to a phosphorescence of the latter in the invisible ultra-violet region. This invisible ultra-violet radiation excites the natural fluorescence of the admixture to the CaS, and that fluorescence together with the original phosphorescence of the CaS produces another tint.

The writer has tried out the above scheme and his experiments have verified Mr. Hammer's claims, at least qualitatively. He cautions the reader who wishes to follow the fluorescent-dye method, to be particularly careful about the purity of his ingredients and the thoroughness of the trituration process. Traces of the dye will suffice.

After this discussion concerning the preparation of the colors, a few words might not be amiss about a peculiarity of the human eye which, at low luminosity, becomes more sensitive to the radiations in the blue end of the spectrum than to those in the red end. This strange behavior is called the "Purkinje effect," and it can be easily detected by observing a geranium plant. While in broad daylight the red flowers are conspicuous for their brightness, and while the green foliage is quite unobtrusive, at dusk the opposite holds true, the foliage being still visibly green but the flower being dark, and nearly colorless. For the same reason objects in the moonlight appear to have bluish tints,

BRIGHT BY NIGHT

Comparatively uninteresting by daylight, the paintings always provoke exclamations of surprise when seen in the dark

notwithstanding the fact that moonlight contains comparatively more red rays than the sunlight. Although the Purkinje effect disappears with very low luminous intensities, it must be considered when working with phosphorescent paints.

TO avail oneself of the considerable contrasts which these paints can bring out, the most logical subjects will be brightly illuminated scenes with deep shadows. CaS, either pure or mixed with green zinc sulfide, lends itself splendidly to sky or snow or water effects. The red and yellow ZnS, either pure or, according to the requirement, triturated with CaS, will produce flame or sun or moonlight effects.

The pigments being of a pasty nature, thick cardboard must be employed to paint the pictures on. The mixing or even spreading of the CaS, which in many cases will occupy a comparatively large area of the picture, should cause no trouble if a non-acid vehicle is employed. Tooth picks or pointed matches should be used instead of ordinary paint brushes. Gum arabic, when diluted in water and kept in solution, will become slightly acid after a while. For this reason it is a good plan to mix the materials only immediately before painting.

Finally, radium treated materials are dangerous and demand very cautious handling on the part of the artist.

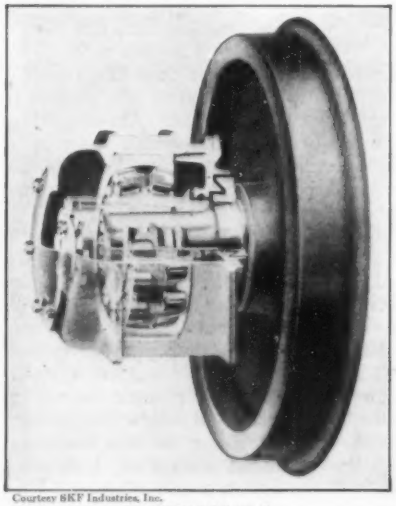
Roller Bearings Smooth *the* Traveler's Road

Trains Equipped With Anti-friction Bearings Run With Minimum Jerk and Are Economical In Operation

By F. D. McHUGH

EXCEPT the use of fire, there has been, perhaps, no greater influencing factor in the development of the human race than the discovery of the principle of the wheel. So far as can be determined, it is a heritage from earliest man, he apparently having discovered this means of lightening his burdens somewhere near the dawn of consciousness of his mastery over the surroundings of daily life. Certain it is that the early Egyptians used chariots, and recent exploration has uncovered inscriptions showing a similar use of wheels, which probably antedates even these.

From remotest antiquity, through the periods of ancient culture up to the present day, man has developed slowly but surely the application of wheels or rollers to his transportation and industrial projects so that now they may be found in practically every piece of mechanism or machinery.



Courtesy SKF Industries, Inc.

"SPHERICAL"

Cross-section showing journal equipped with barrel-shaped roller bearings of solid steel

The question of bearing friction and lubrication did not, however, become important until Watt, in 1769, patented the improved steam engine. With the coming of greater speeds, lubrication was carefully studied so that greater efficiency could be obtained. In the beginning of the so-called machine age, babbitted and bronze bearings were developed and attained widespread use, mainly because they could be easily and smoothly machined, were elastic enough to take the strain and wear off the axle, and could be replaced after normal wear at a minimum expense.

In the latter part of the nineteenth century, machinery began to feel the impetus of the universal desire for still greater efficiency and less noise. The first anti-friction bearing, the ball bearing, then came into existence. In principle, it was the same old wheel that man discovered ages ago, but it had the advantage that where it was interposed between two surfaces that would otherwise have to slide, it always presented a circular shape regardless of its position. It "floated" entirely independent of any self-contained axle.

THE ball bearing has never been improved upon for certain purposes, but it has the disadvantage that its load surfaces are two diametrically opposed points. Since the load on an axle must be concentrated on these two points, ball bearings are not easily adaptable to carrying extremely heavy loads.

For many years, railroad men were oppressed with the problem of finding a bearing suitable for their rolling stock, one that would resist effectively the terrific shock and jar of fast-moving, heavily laden trains, reduce starting torque, and eliminate some of the many upkeep costs of bronze bearings. They turned to anti-friction bearings 25 years ago, but for years could do nothing but play with the idea. Their first promise of success came 15 years ago when roller bearings were applied to railroad-car journals in Europe, and three years later appeared in America.

The principle of their effectiveness lies in the fact that, while they interpose rolling bodies between moving surfaces in a manner similar to that of ball bearings, they present *line* rolling surfaces at the peak and at the base, as compared to the two point contact surfaces of the ball bearing. Heavy loads on any axle equipped with roller bearings are, therefore, well distributed.

RAILROAD men had as the basis of their hope for ultimate success, the irrefutable proof of the heavy-duty capacity of roller bearings, for they had been developed to a particularly efficient point for automobile service—a service that most nearly parallels railroad operation in severity.

In working out a design for journal roller-bearings, engineers first studied the situation carefully so as to be fully cognizant of the problems they had to face. Then followed much experimental work and research, and many laboratory tests were made. For to apply roller bearings to the journals of railroad cars, the bearing must possess the following characteristics and qualities:

(1) Low frictional resistance.

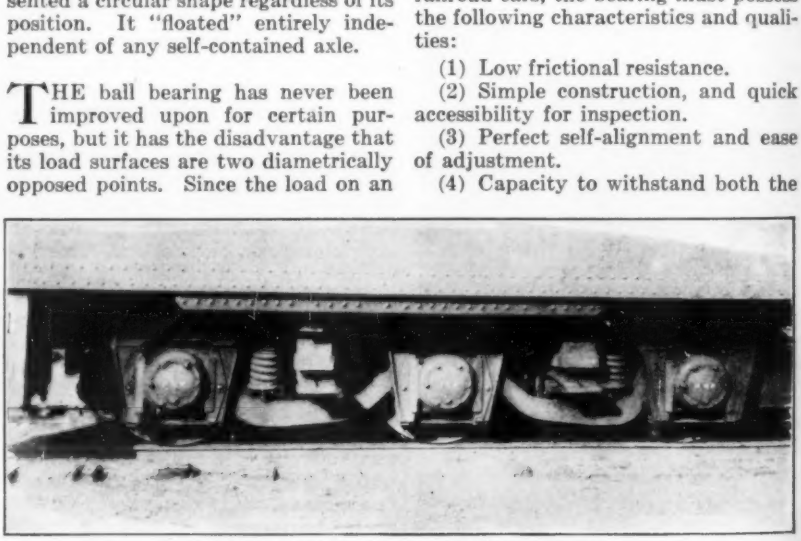
(2) Simple construction, and quick accessibility for inspection.

(3) Perfect self-alignment and ease of adjustment.

(4) Capacity to withstand both the vertical load and lateral thrust of a heavy, fast train.

(5) Long and efficient life at a minimum maintenance cost.

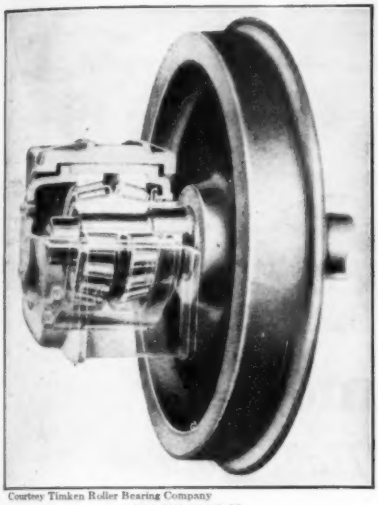
Starting, acceleration, and friction of bearings while the train is in motion were the most important points of consideration. Laboratory tests have shown that the starting torque of a car with roller-bearing journals is appreci-



INSTALLATION ON A SIX-WHEEL TRUCK

The six-wheel Commonwealth truck shown here is equipped with the bearings illustrated at the left. The lubrication inspection hole and plug are on the lower edge of the protecting cap

ably lower than that of a standard bronze-bearing car. Road tests also have shown a reduction of the bearing friction resistance of a train so equipped. Figures showing the pound per ton saving in draw-bar pull cannot, however, be given, since the results for different makes are slightly at variance with each other.



Courtesy Timken Roller Bearing Company

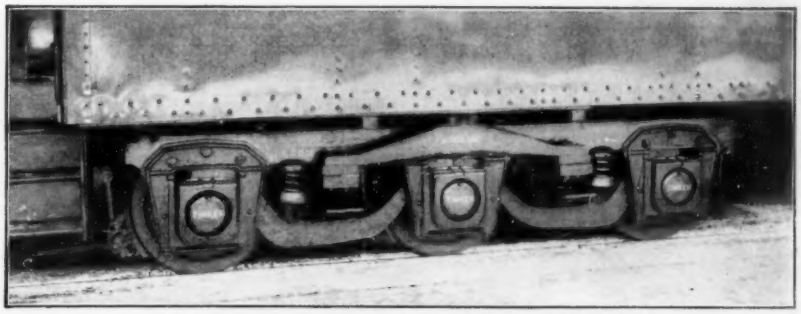
"TAPERED"

Phantom view of solid steel tapered roller bearings mounted on a railroad-car journal

Road inspection of roller-bearing journals under heavy passenger cars have disclosed the fact that the temperature rise averages about 50 degrees Fahrenheit—much less in each test than it was on the bronze-bearing journals of the same train.

The roller bearing unit, as perfected for railroad car journals, is simple in construction; it is essentially a series of rollers held between two races, the inner race being mounted on the axle and the outer one attached to the housing. Construction varies with the manufacturer, but the rollers are either cylindrical or of a modified-cylinder form.

Naturally since this application of roller bearings is of comparatively recent date, their useful life in this service has not been determined. It is said, however, that the earliest American installation of them by SKF Industries, Incorporated, on six standard passenger cars of the Pennsylvania Railroad, is still giving efficient service after running between 700,000 and 800,000 miles over a period of seven years. The Hyatt Roller Bearing Company, a division of General Motors, claim for their first installation of five years ago, efficient service of 342,000 miles to date. One manufacturer estimates a useful life of 20 years for journal roller-bearings, and further estimates the maintenance cost at about 20 to 25 dollars each per year for that period, compared to at least 150 dollars each per year for bronze bearings.



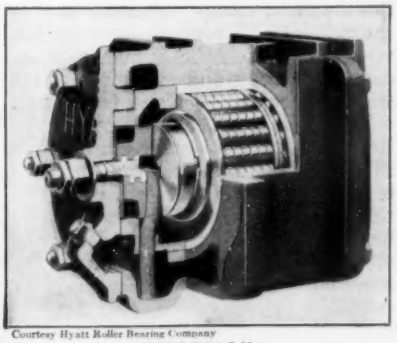
ANOTHER SIX-WHEEL TRUCK INSTALLATION

The plate cover on each journal equipped with the roller bearings shown at the left has two plugs—one at the top and one at the bottom—for the periodic inspection of the lubricant

THE main advantages of roller bearings for railroad rolling stock may therefore be summarized as follows: elimination of the starting jerk which requires great power and gives discomfort to the passengers, while placing excessive strain on the draft rigging; quicker acceleration and therefore the adoption of speedier schedules; prevention of hot-boxes; economy of operation because no attention is required except an inspection of lubricant every few months; and their (estimated) extremely long life in this service.

We may conclude that journal roller-bearings have passed their period of probation. The outstanding success of the various types made, and particularly that of the 15-year installations in Europe and seven-year installation in America, seems to indicate a widespread use of them in the future. Even now, upwards of a hundred American and Canadian railroads are using them, and they are to be found on railroads of a score of other countries.

Their dependability is further shown by the fact that recently a test application was made by the Timken Roller Bearing Company on the inboard type trucks of a locomotive tender, and by the installation of the SKF Industries, Incorporated, applied to locomotive booster trucks and leading trucks. This latter installation is noteworthy because of the extremely hard service called for in this position since every curve or track irregularity imparts a tremendous shock to the leading truck of the locomotive.

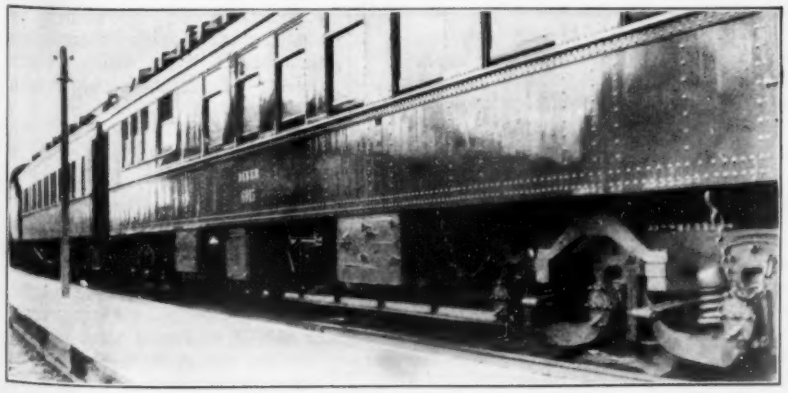


Courtesy Hyatt Roller Bearing Company

"HELICAL"

Journal box having roller bearings of steel, helically wound, hollow cylinder type

Roller bearings have helped to solve one of the railroad men's problems—for the time being, at least. There is little doubt that they can be developed further, and it is almost as certain that in years to come, many more railroads will adopt them. To the layman, this latter fact is perhaps the most vital of all, for it will mean a great increase in his comfort while riding on trains.



DINER TRUCK INSTALLATION

In this, the standard A. R. A. truck equipment is but slightly changed. Oil level gage, together with oil strainer which is made of matted felt, are clearly shown in sectional view at right

THE AUTHOR

In his right hand he holds a hammerstone. At left is a view of the foreshore and cliffs at East Runton, Norfolk, England, where he found early Pleistocene implements, some of them uncovered by the water only at low tide

Making Flint Implements

An Elementary Lesson in Copying the Handiwork of Our Prehistoric Ancestors

By J. REID MOIR

Fellow of the Royal Anthropological Institute of Great Britain and Ireland

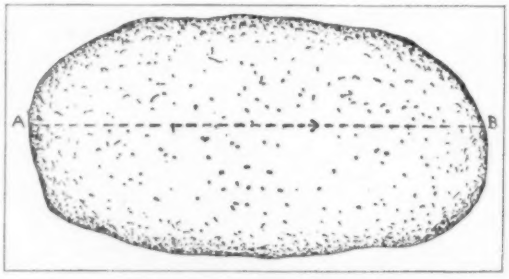
With drawings by the author

THERE is no doubt that the industry of stone implement flaking, which was continued during hundreds of thousands of years in the past, is one of the most important ever undertaken by man. For the production of weapons and implements of stone must be regarded as the first and vitally necessary step in the widespread control over its environment which the human race today possesses, and without which we would be but poor and feeble folk.

When this is realized it becomes clear that the Dawn Man of Pliocene time, who first thought of flaking a flint to a rough cutting edge, was one of the greatest benefactors of mankind; and in all seriousness it is suggested that some adequate and suitable memorial of appreciation should be made to this unknown and immensely kind individual who without question enabled man to set out upon his course of progress and achievement.

IN the whole of my researches into the antiquity of the human race there has been nothing which has given me more pleasure and interest than the flaking of flint inplements by my own unaided efforts. I have always scorned to use a steel hammer in this work and have accomplished my results by means of a hammerstone of quartzite or other hard rock, such as was used by prehistoric man.

Though I can by this means now produce flint implements of various types, I do not wish it to be imagined that I can imitate the skill of the ancient flint flakers, because that is beyond my powers. In fact, the more I study this matter, the greater becomes my respect and admiration for these early artificers whose knowledge of the raw material they handled was so profound and their control of it so masterly. But nevertheless it is possible to visualize the main lines upon which they worked, and I propose as briefly and lucidly as I can, to describe them to my readers.



THE FIRST STEP OF WORK

Figure 1: *The flint nodule as found in the field is to be split in half, along the line A-B*

In the first place, then, it is necessary in setting out to make a flint implement to provide oneself with a thoroughly sound nodule of this rock. If the flint has been attacked by thermal changes and is fissured with cracks, or if it possesses cherty or other inclusions in its mass, it is of no more use for making into an implement than would be a piece of decayed or unsuitable wood.

Having procured the right kind of flint nodule, it is needful to get a series of quartzite pebbles of different sizes and weights suitable for the varying kinds of flaking that will be employed in making the implement. We may suppose that the flint nodule selected has a rounded surface. We will find if we attempt to remove flakes from this surface by means of blows with a hammerstone, that very little success will follow our efforts. It becomes clear, in fact, that in order to make a satisfactory start in our work we must by some means provide a more or less flat surface upon which we can deliver flake-removing blows with precision.

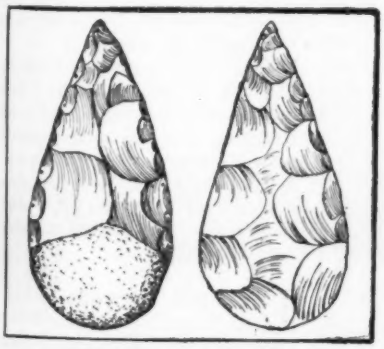
SO we take the flint nodule in the left hand, and holding one end of it upon the left thigh—which if we are wise is protected with a folded sack or other cloth—and deliver blows with our heaviest hammerstone upon the uppermost end of the nodule. After a little practice it will be found that by this procedure we can split the nodule in half, along the line A-B, Figure 1, and so provide ourselves with a large and more or less flat surface, such as we require.

Now this surface is known as the "striking platform," and it always has been and always must be of fundamental importance in implement making. If a series of flakes from any prehistoric workshop site is examined it will be seen that just above the cone of percussion caused by the blow is to be found a remnant of the original striking platform which was carried away when the flake was removed.

Let us then proceed with the flaking of one of the halves of the nodule we have fractured, and produce some of these flakes for ourselves. We are going to make a paleolithic implement of pointed form, and so, taking one of the hammerstones of lighter weight in our right hand, and holding one half of the nodule with the flat surface uppermost in our left, we deliver a series of blows upon this surface near to its edges as indicated by dots in Figure 2.

IF we do this skillfully, we will find that when we turn the flint over, the under surface of the flint is becoming covered with flake scars, and on the ground at our feet will be seen a quantity of flakes, each of which will bear a small portion of the striking platform which we have removed by our blows.

Here it may be well to say something more about these flakes, which may be regarded as the equivalent of the shavings in a carpenter's workshop. Although this is the case, they are of much greater interest and importance. Flint, in common with glass, obsidian (a volcanic glass), and other substances has, when struck, a conchoidal fracture. For example, if you deliver a sharp blow upon the center of one of the surfaces of a cube of glass you will find



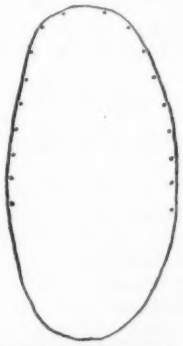
FINISHING THE WORK

Figure 4. Left: *One side finished. Dots indicate blows to be made.* Right: *Completed*

that, by doing so, you have formed a perfect cone in the mass of the glass. In the same way, if you give a similar blow upon the surface of a sound piece of flint and then gently tap the parts surrounding the point where the blow fell, these will fall away and a beautifully symmetrical cone of flint will be revealed.

Now, if we examine the flakes we have struck off in our implement-making experiment, we will see the apex and one half or so of the cone of percussion present as a rounded, bulbous, swelling, bearing upon its surface a small flake scar called an "éraillure." This is observable in each case. Further we will notice that, very often, conchoidal ripplings centering around the point of impact are visible upon the surface of the flake, which usually bears also a series of tears or fissures produced by the blow. These also radiate from the point of impact. Figure 3.

I HAVE mentioned these characteristics of flakes because when they are all found upon specimens recovered from ancient deposits, they afford very strong evidence that such flakes are



THE SECOND STAGE

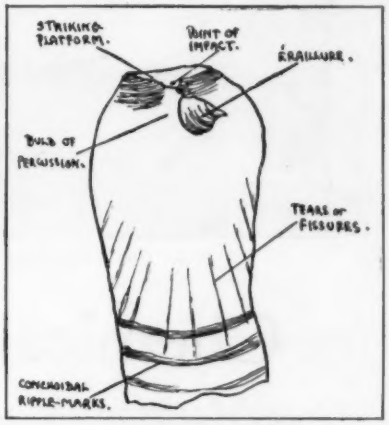
Figure 2: *The flat surface after splitting nodule. Next, deliver blows on spots marked*

the result of human handiwork, especially when they bear upon the side opposite to that on which the cone of percussion appears, the remains of flake scars produced in flaking the flint prior to the detachment of the particular flakes under examination.

Returning now to the split nodule which we are making into an implement we notice that its outline is somewhat ragged, so we take up one of the smaller hammerstones and remove the outstanding portions by careful blows. When this is done the specimen has assumed the form shown in the left-hand drawing of Figure 4, and is comparable in form with large numbers of paleolithic implements found in Pleistocene deposits in England and in western Europe.

BUT, as we have set out to make a really good implement, we may as well produce flaking all over the flattish surface representing the original striking platform, because in many cases, paleolithic man accomplished this with ease. So, by means of a hammerstone of medium weight, we deliver a series of blows upon the surfaces of the flint as shown by dots in the same sketch, and by this means we remove the flakes required and the specimen is at last finished as in the right-hand sketch, Figure 4.

Our implement has some cortex left at the butt end for comfortable prehension, its edges are straight and



VARIOUS DETAILS

Figure 3: *A study of this sketch will show that certain results are always produced*

sharp, and with it we can do many things, from killing an enemy to shaping wood, and if we were living in prehistoric times we would with such a possession go upon our way rejoicing.

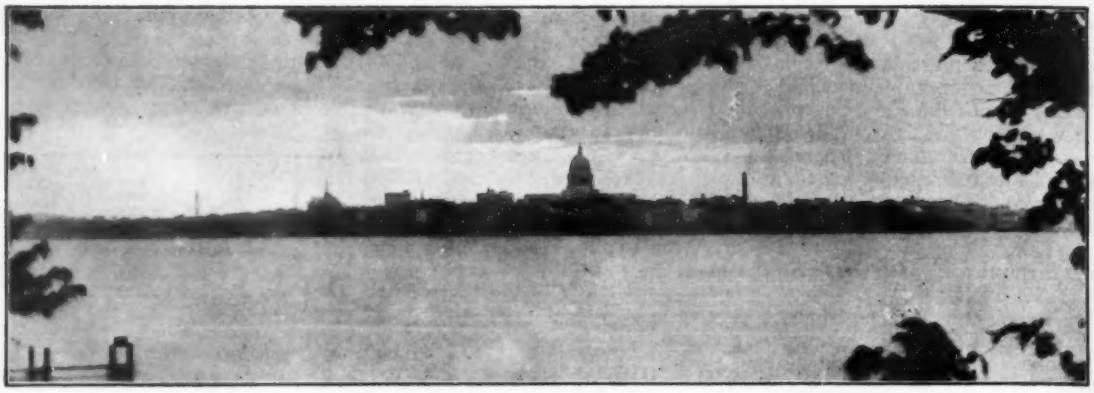
In this article we have described merely the manner in which one type of flint implement was made, yet the principles outlined apply to them all, although in later stone-age times man had learned how to remove flakes from the edge of a flint by pressure of a bone or stone point. With a little practice this can easily be accomplished, and I have found the wards of a key very useful in so removing flakes.

TO flake flint successfully one must have much patience. Often the finishing blow may break the specimen in half, as sometimes happened in ancient times, and the labor expended upon it be wasted. But, in spite of such annoying experiences, flint flaking is a most interesting occupation; and by means of it, as I have said, it is possible to realize exactly how our earliest ancestors made their stone implements and weapons.

In some cases the knowledge of how to make these things has led to forgeries being foisted upon collectors, but those who know their business can readily detect these when they come under their notice.

To be able to flake flint successfully enables the possessor of this art to enter more fully into prehistoric man's past than those who have not such knowledge, and it opens up a field of scientific research which even yet is by no means fully explored.

¶ *The third of Mr. Moir's articles on flint will follow in an early issue.*



A SECTION OF LAKE MONONA ENTIRELY FREE OF WEED GROWTHS

Chemicals Destroy Lake Weeds

How Madison, Wisconsin, Has Solved the Problem of Ridding Nearby Lakes of Obnoxious Weed Growths and Algae

By JACK W. JAREO

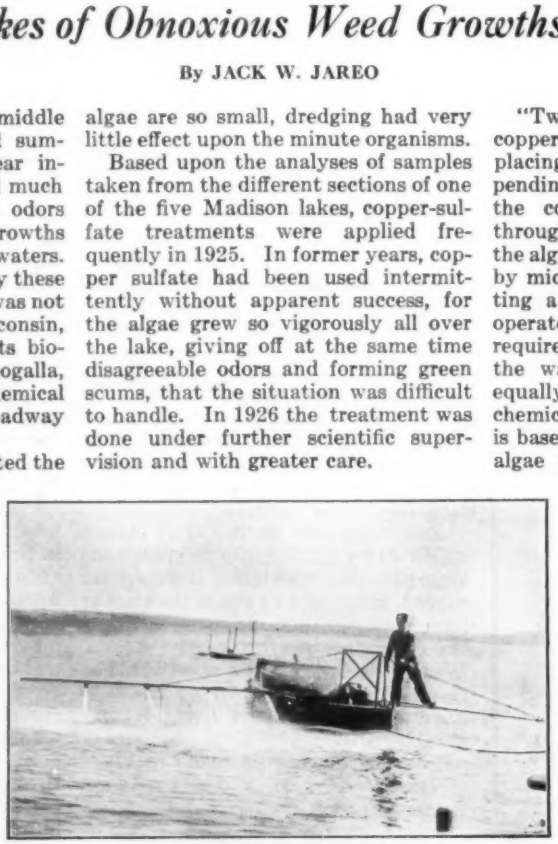
THROUGHOUT the middle west, communities and summer resorts located near inland lakes have suffered much discomforture because of bad odors caused by vegetable and algae growths upon the surface of nearby waters. Many cities have tried to destroy these plants by various means, but it was not until the city of Madison, Wisconsin, through the investigations of its bio-chemist, Dr. Bernard P. Domogalla, began destroying weeds by chemical methods that any marked headway was made.

Many communities have enlisted the aid of Dr. Domogalla. As the results of chemical treatment of lake odors becomes more successful each year, more cities are employing this means to rid their nearby lakes of weed growth and the algae scum that give rise to the unhealthy and unpleasant odors.

MANY methods were tried in an attempt to eradicate these unpleasant odors, but no marked success was seen in the effort to destroy weed and algae growth until the use of chemicals was resorted to, particularly copper sulfate. In 1925, fifty thousand pounds of copper sulfate were used by bio-chemists to treat the lakes near Madison, and in 1926, sixty thousand pounds more of this chemical were used in successful experiments.

Before any thought was given to the use of chemicals to treat the weed growth, many forms of dredging and cutting were used; but since the algae are so small, dredging had very little effect upon the minute organisms.

Based upon the analyses of samples taken from the different sections of one of the five Madison lakes, copper-sulfate treatments were applied frequently in 1925. In former years, copper sulfate had been used intermittently without apparent success, for the algae grew so vigorously all over the lake, giving off at the same time disagreeable odors and forming green scums, that the situation was difficult to handle. In 1926 the treatment was done under further scientific supervision and with greater care.



THE SPRAYER IN ACTION

A power-driven pump mounted on the scow is spraying a copper-sulfate solution over the surface of the water

"Careful investigation," declared Dr. Domogalla, "soon proved that it was cheaper to kill the objectionable growths as they start, and before the organisms have developed to such an extent as to form a heavy mass, than to wait until the algae have fully matured.

"Two methods of distributing the copper sulfate have been applied. By placing this chemical in bags and suspending two from each side of a launch, the copper sulfate was distributed throughout a section of the lake where the algae thrived thickest or were found by microscopic examination to be getting a fresh start. The launch was operated at a speed that would give the required amount of copper sulfate to the water as systematically and as equally as possible. The amount of chemical to be carefully administered is based upon the number and kind of algae present and the consideration that no fish are to be injured by the treatment."

Dr. Domogalla found through careful study and research that the copper-sulfate dragging method was preferable in cases where a great portion of the algae are below the surface of the water, and where the lake is well stirred by the wind.

IN general, from one to two pounds of the substance for each million gallons of water are effective in practically eliminating the most noticeable forms. The copper-sulfate spraying method is more efficient in cases where the algae come to the surface, and for shallow water, where a boat would stir up the mud and debris on the bottom.

The investigation also brought out the fact that some algae were more sensitive to copper-sulfate treatment than other types. The close inspection of bays and shallow shore lines

ALGAE SCUM

A view of the undesirable plants on the surface of Lake Monona before spraying

pointed to the fact that these places were the growing centers of many of the algae; the weeds in these areas affording protection from the copper-sulfate solution.

The spraying method was applied on calm waters to the type of algae that came to the surface. Copper-sulfate crystals were dissolved in lake water and sprayed by hand sprayers. Recently, however, Dr. Domogalla has recommended a mechanical sprayer that can be operated from a scow at a much greater speed and over a larger area.

BESIDES combating the algae directly by the use of copper-sulfate solutions, action was taken by chemical experts at Madison to reach the source of the algae and prevent their first growth. Scientific investigation proved conclusively that soluble phosphorus, the different forms of nitrogen, as well as the types of bacterial flora living in the lake waters are the growth-promoting factors of the algae and obnoxious plants. By eliminating these plant foods and harmful bacteria, the growth of algae can be readily checked.

While the algae could readily be taken care of through the application of copper sulfate, the water weeds were another source of unpleasant odors to those who live near Madison's lakes. To combat these weeds, a power-driven cutter, mounted on a scow so that a 10-foot swath was cut about three or four feet below the surface of the water, was placed into operation. The loose weeds would float about the lake with the wind, and would be gathered by men employed to remove them as the weeds were washed to shore.

TOWARD the end of the 1926 season, steel cables were tried in an attempt to find a more efficient means of removing the great mass of weeds that thrive in all the shallow parts of the lakes. To 1000 feet of three quarter inch steel cable, clips were attached every 10 to 20 feet, around which the weeds were caught. The cable was unreeled into the water in the shape of a large loop, one end of which was securely fastened to a driven post, and the other end attached to a tractor with pulley attachment which slowly pulled the cable through the water.

Cabling was found to be very effective for the removal of the larger and stationary plants, and during the 1926 season more than 300 tons of weeds, with most of their roots, were removed. Since certain of the smaller and floating weeds, like the duckweed, could not be removed by the cable process, arsenical compounds were found to be very effective in destroying this type and also some of the larger varieties.

"During 1927," explained Dr. Domogalla, "many chemicals other than copper sulfate and arsenical solutions were tried in the Madison lakes to determine if a still better and more effective chemical could be found, as the chemical methods of combatting lake weeds and algae have a decided saving of approximately 800 dollars monthly in labor costs.

"One of the most effective chemicals

BEFORE TREATMENT

A hand sprayer has effectively cleared this shallow bay of the algae and weeds

tried during the early part of 1927 was a solution of white arsenic. A week after treatment, a large area before clogged with weeds was cleared, and the shore line covered with dead growth. The chemical proved to be very effectual, but because of the skin eruptions caused to spray operators by the chemical, this method of spraying had to be discontinued.

"ANOTHER chemical which obtained fair results for the experimenters was a solution of sodium arsenite, or rather, a solution of arsenic and lye. This solution was prepared by boiling 300 pounds of arsenic and sodium hydroxide together. This chemical mixture was sprayed over a portion of lake water where no arsenic had been sprayed before, with the result that about 90 percent of the pond weeds died; most of them drifting to the shore where arsenic was found to be present in the weeds as well as in the roots.

"Experiments were also made with chloride of lime, unslaked lime, lye, copperas, rock salt, sodium chlorate, and niter cake. The results of these treatments were indeed gratifying.

SECURING THE STEEL CABLE

The cable is fastened on one side of the lake and dragged through the water by the tractor, with pulley attachment, on the opposite bank

FLOATING TO SHORE

The large weeds, after they have been cut by the cable, float to shore with the wind and are gathered by men employed for that purpose

Industry Depends on Scientific *Research*

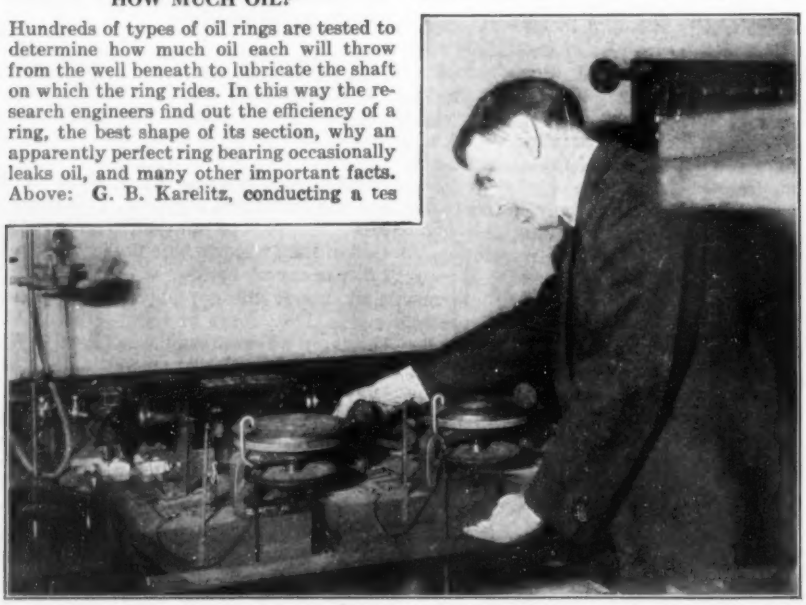
All photographs courtesy Westinghouse Electric and Manufacturing Company

HOW MUCH OIL?

Hundreds of types of oil rings are tested to determine how much oil each will throw from the well beneath to lubricate the shaft on which the ring rides. In this way the research engineers find out the efficiency of a ring, the best shape of its section, why an apparently perfect ring bearing occasionally leaks oil, and many other important facts. Above: G. B. Karelitz, conducting a tes

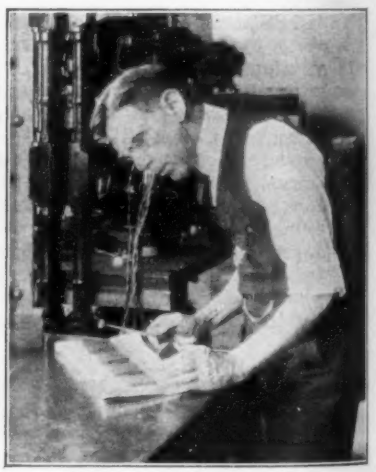
HOW MUCH ABUSE WILL A METAL STAND?

The force of howling winds on the struts of an airplane or the strain of an ocean flight on the vital parts of an engine are duplicated on this machine. Materials, metals, et ceters, for airplanes are put through a fatigue process on this mechanical metal-abuser to determine their limit of strength. A sharp note from the machine tells P. L. Irwin that a test piece has failed, and a meter shows how much punishment it took to break down the unit



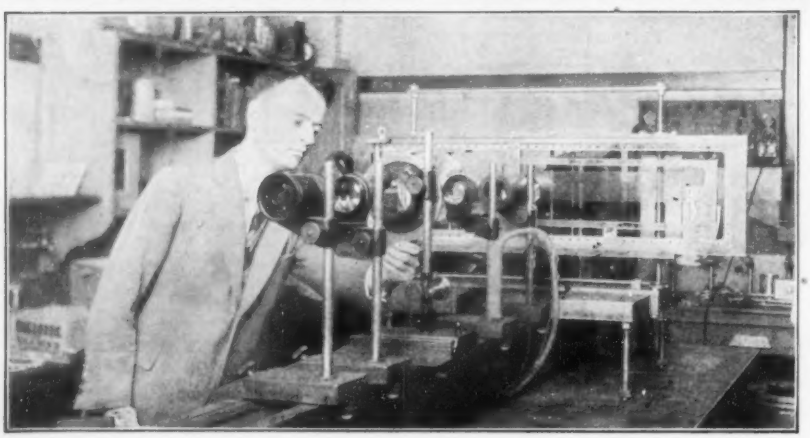
◄ COMMUTATOR BRUSHES

Careful and detailed tests of brushes are constantly being made for comparison. Knowledge of friction pull, spring tension, and voltage drop of brushes are vitally important to the proper operation of a motor



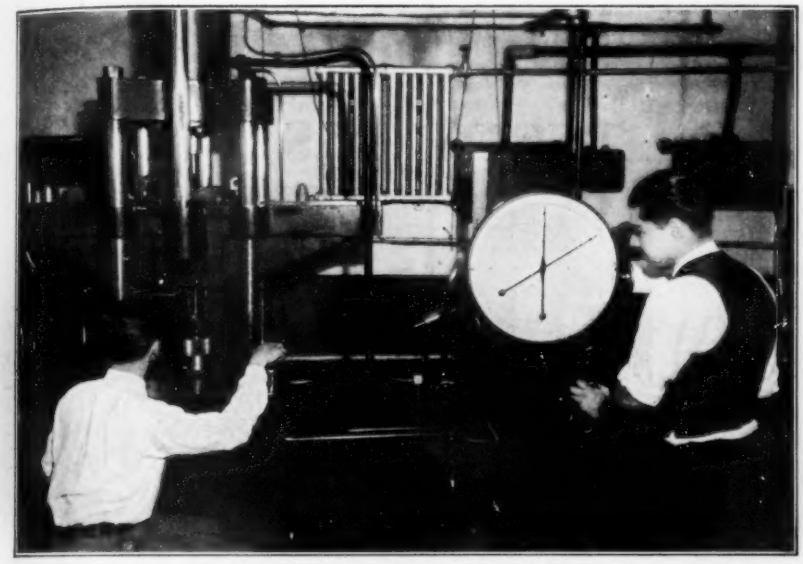
BRUSH "XYLOPHONE"

G. M. Little has demonstrated that the tone of a carbon brush, when struck, is an indication of the quality of the brush. This test has proven successful in the selection of best quality brushes for railway motors



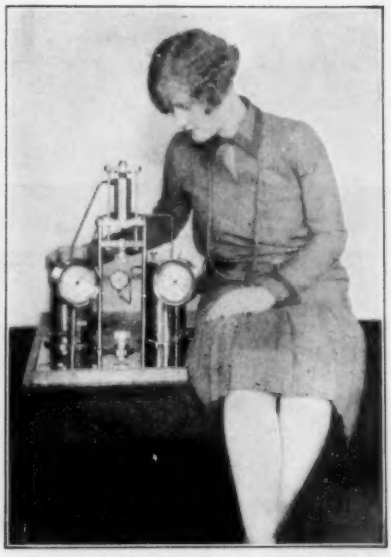
◄ STRENGTH SHOWN BY LIGHT

This analyser, consisting of lamp, two series of lenses, and two crystals, enables R. V. Baud to determine stress and strain in a complicated section of a machine, where this is impossible by mathematics. A celluloid model is used for the test but the findings apply to steel because steel behaves similarly under working conditions



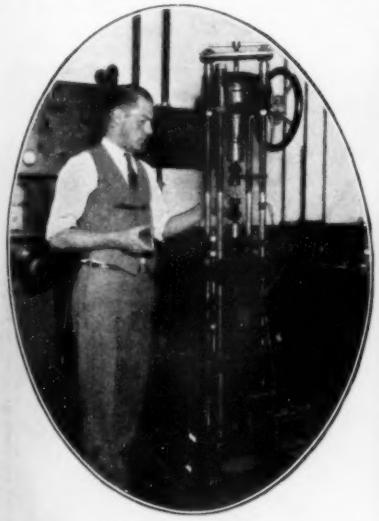
HYDRAULIC TESTING MACHINE

Tension, compression, or bending tests are possible with this machine which can exert force enough to lift 50 tons or barely enough to break a hair. Deflection of gear teeth under load, characteristics of electric welded joints, the "give" of porcelain insulators, et cetera, all come within its daily routine. Above: microscopic examination of steel bar being stretched. Tension applied to the test piece is read directly from the large dial



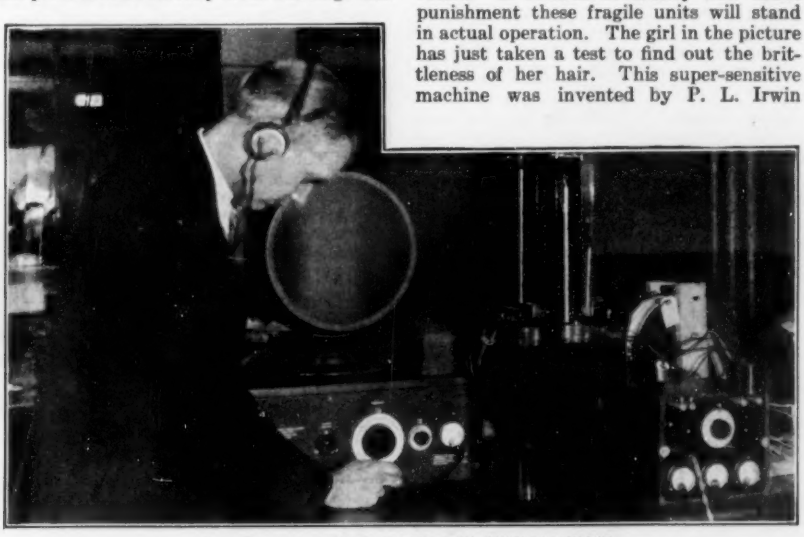
FRAGILE-MATERIAL TESTER

Operated by compressed air and oil, this new machine was designed for testing delicate materials such as hair springs, radio filament wires, tiny spring washers, et cetera. It records accurately how much punishment these fragile units will stand in actual operation. The girl in the picture has just taken a test to find out the brittleness of her hair. This super-sensitive machine was invented by P. L. Irwin



PUSH AND PULL

Airplane connecting rods, and similar machine parts, must stand rapid cycles of tension and compression. This magnetic tester, without moving parts, pushes and pulls the test piece at a rate of 1800 times a minute



RADIO WAVELENGTH DETERMINATION

Broadcasting companies must operate within 500 cycles of their assigned frequency according to a ruling of the Radio Commission. In this photograph, Richard Hitchcock is shown using the machine which utilizes a piezo-electric crystal for checking frequency. With this machine, a deviation in the broadcasting frequency of 20 cycles in a million can be determined, if necessary, by testing and then consulting calibration chart

IT is on pioneer work in the development of new inventions, new materials, and new methods, that industry depends for its steady progress. Realizing the imperative necessity of investigative work in proper co-ordination with manufacturing processes, many large companies make a business of research. For new discoveries, they rely, not on the chance brilliance of independent workers with inventive propensities, but on an organization of scientific engineers. The Westinghouse Electric and Manufacturing Company began this sort of work about 25 years ago, testing of materials being also included among the duties of the newly created department. Research as a separate department was organized a little over 10 years ago, and shortly afterwards there appeared the research laboratory building that stands on a hillside a mile away from the main plant at East Pittsburgh, Pennsylvania, far enough away from the factory to be undisturbed by vibrations, noise, and undesirable electronic conditions, yet not so far as to be out of touch with actual production problems. There, under the direction of S. M. Kintner, more than 70 research engineers, assisted by about 40 artisans and machinists, devote their entire time to the study of baffling scientific problems. In the routine of their work, these men invent many new and intricate machines for carrying out their tests to more accurate and definite conclusions than was previously possible with existing machines. Needless to say, the results obtained by them exert a great influence on manufacturing plant processes.

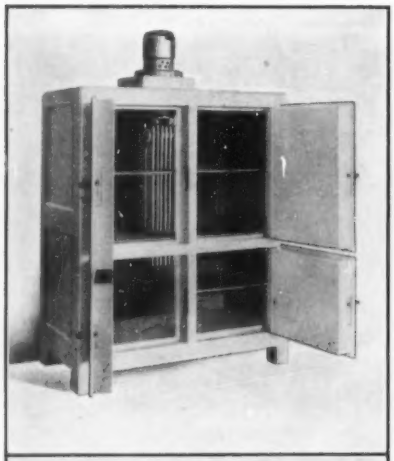
Household Inventions

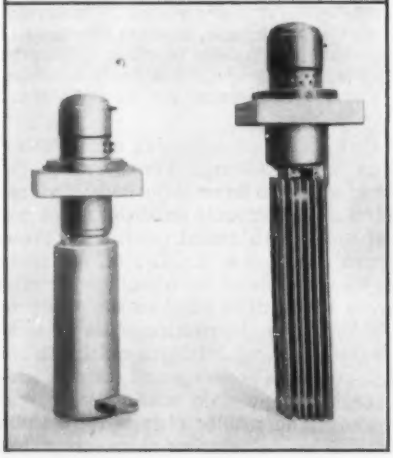
DUST RECEIVER

In an apartment or other place where it is inconvenient to shake out a mop, this shaker cabinet should be useful. Mop or duster is inserted through slot in front; dust is emptied from drawer at bottom.—*Sanitary Dust Receiver Company, Malone, N. Y.*

SAFETY OVEN SHELF

This arrangement of shelves is adaptable for use in any oven to obviate tipping or jamming when roasts or cakes are drawn forward for inspection, turning, et cetera. A framework to fit any stove is clamped against inner walls of the oven, and two sliding shelves are held in the slides and cannot come out unless they are released.—*William Parke, Inc., 537-549 South Jersey St., Camden, N. J.*





A Reader Writes:

"Your new departure of printing the names and addresses under photographs of new inventions is sane, handy, and appreciated by subscriber Thomas W. Hicks."

How do *you* like it?

AUTOMATIC REFRIGERATING MACHINE

This compact machine recently introduced from Germany is controlled by thermostat, and no visible parts move while it is in action. It is said to be easily installed, and to require no supervision. Machines of this kind are made in capacities of 150 to 10,000 calories for small home refrigerators or for butcher shops, et cetera. In the photograph at the lower left are shown two units of different capacities. The dome at the top is the enclosed electric motor; immediately beneath is the condenser; and below that, the evaporator and the ice cube "drawer."—*Traugott Tschudi, Post Office Box 1333, Paterson, N. J.*

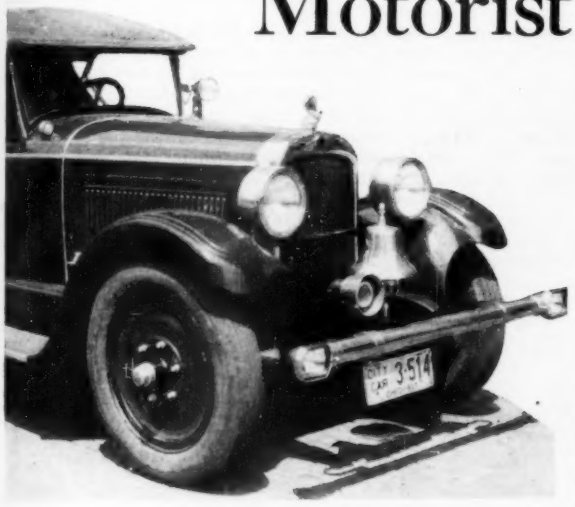
FRUIT JUICE EXTRACTOR

Like the extractors used at soda fountains, except that it is hand-operated, this new machine has a porcelain bowl and strainer. It is fitted with vacuum-cupped rubber feet so that it will hold solidly to an enameled kitchen table or sink. Gets all the juice.—*Marshall Field Company, Household Utility Department, Chicago.*

COMBINATION SHAKER

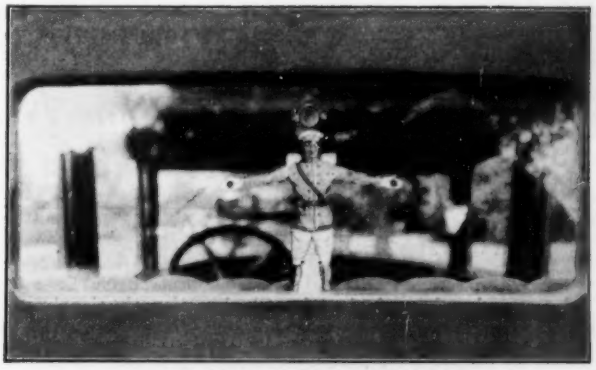
Holds both salt and pepper, and is made of bakelite. Salt may be shaken out by first pressing button shown—marked salt—and pepper is released by pressing the button on the opposite side. Convenient for camping or traveling.—*The Baldwin Handee Shaker, 1619 W. Fifth Ave., Gary, Ind.*

Inventions *for the* Motorist



BUMPER LIGHTS

This attractive bumper has a light mounted in each end to direct light to the ditch and on the road instead of into the approaching driver's eyes. Bumper is husky, and comes in black, nickel, or different colors of duco.—*Bright Bumper Sales Company, 541 West 34th St., New York City*

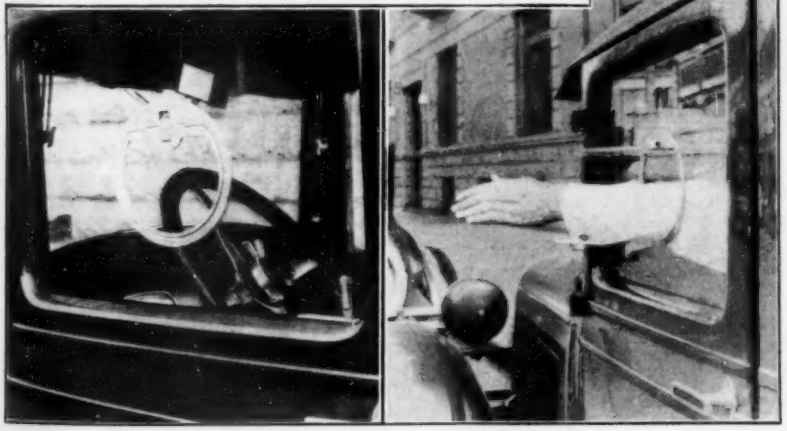


TRAFFIC COP STOP SIGNAL

Operating automatically due to the momentum of the car in the rear window of which it is installed, this miniature policeman throws out his hands in imitation of a traffic policeman and indicates to the car behind what you are going to do. Has no breakable electrical or mechanical connections.—*The Traffic Cop, 240 Clinton St., Buffalo, N. Y.*

HEEL PROTECTOR ➤

The heels of the woman driver's shoes will not be scuffed when operating the car if she wears these new guards which buckle over any type of heel. Available in various colors.—*The Edward E. Kahn Company, 291 Adams St., Brooklyn, N. Y.*



▼ GEAR SHIFT ASH TRAY

The knob on the end of the gear shift rod has been given an added duty. This new ash tray is simply a cupped knob that holds the lighted cigarette or receives the ashes. A simple adapter fits it to any shift rod and its color adds a touch of brightness.—*Fisher and Rockwell, 7700 to 7740 South Chicago Avenue, Chicago*

▲ "PORT HOLE"

This hinged port—plate glass in a light metal frame fitted tightly into the glass of the door next the driver's seat—fills a long-felt want. For cold-weather driving in a closed car, it allows hand signalling and provides for a moderate amount of ventilation. It is quickly installed with special tools supplied by the manufacturer for cutting the glass and installing the metal frame.—*Harry W. Cooper Company, 2244 S. Michigan Avenue, Chicago*

◄ DEATH'S HEAD SIGNAL

The skull and cross-bones has long been used as a sign of danger on medicine labels. Now the skull has been adapted for automobile stop signals. A red light inside the head causes the skull to grin suggestively and warn car drivers behind when the car is about to stop. —*H. and S. Manufacturing Company, Wilkinsburg, Pa.*

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Horn Operates Traffic Lights

A TRAFFIC signal operated by sound waves has been devised by Charles Adler, well-known signal engineer of Baltimore. The device is intended for the protection of crossings on country highways or in suburban areas away from congested districts. Its chief usefulness comes at the type of intersection at which a main artery of travel is crossed by a road carrying a lesser volume of traffic.

At a crossing of this character a signal controlled by timing mechanism is apt to create endless congestion because of its frequent interruptions to the streams of traffic moving at high speed along the principal thoroughfare. The interference comes at regular intervals, regardless of the state of the traffic, and halts travel on the main road even when there is a complete absence of vehicles in the intersecting channel. The new signal is designed to do away with this needless interference with the principal flow of traffic.

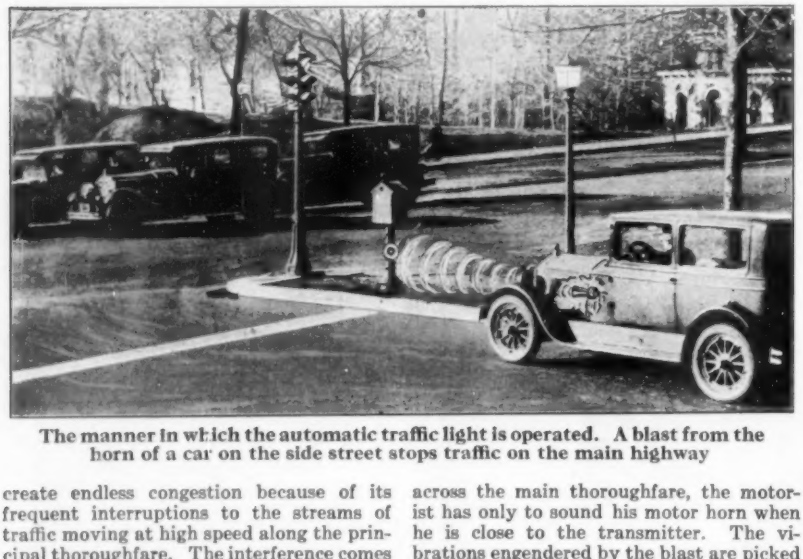
The device involves the use of a three-color automatic signal controlled by the actual traffic movement along the minor thoroughfare. Situated at the intersection, the signal normally displays the green light for travel along the main highway and the red light for vehicles in the intersecting channel. These lights remain fixed until an automobile approaches along the minor road. Facing the red light, the driver of this car comes forward at slow speed. Near the corner he finds a microphone—an ordinary telephone transmitter—affixed to a post.

To procure for himself a clear passage across the main thoroughfare, the motorist has only to sound his motor horn when he is close to the transmitter. The vibrations engendered by the blast are picked up by the microphone and communicated to the mechanism of the signal. Actuated by these vibrations, the mechanism shifts electrical circuits and changes the lights on the main artery from green to amber followed by red. The same operation causes green to appear for the crossroad, permitting the motorist who sounded the horn to cross or enter the main channel of traffic.

The new position of the lights remains fixed for 10 seconds, or for such cycle as may be predetermined by the adjustment. At the end of the cycle the lights are restored to normal, allowing the resumption of travel on the main road and blocking crosswise movement.

When two or more cars approach in close succession along the minor road, each fresh blast of a horn starts the cycle anew, holding the crosswise channel open for travel for a full 10 seconds after the final blast.

The first installation of the new signal has been made by the Baltimore police department at a minor intersection of Charles Street in an outlying district.



The manner in which the automatic traffic light is operated. A blast from the horn of a car on the side street stops traffic on the main highway

A River of Mud

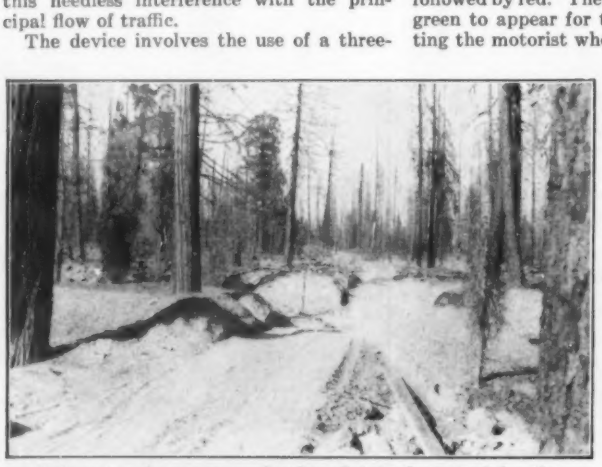
IS California's "river of mud" under control?

It has been a hard battle, but officials of the McCloud River Railroad, farmers along the Sacramento River, and others interested, believe that they have won the fight.

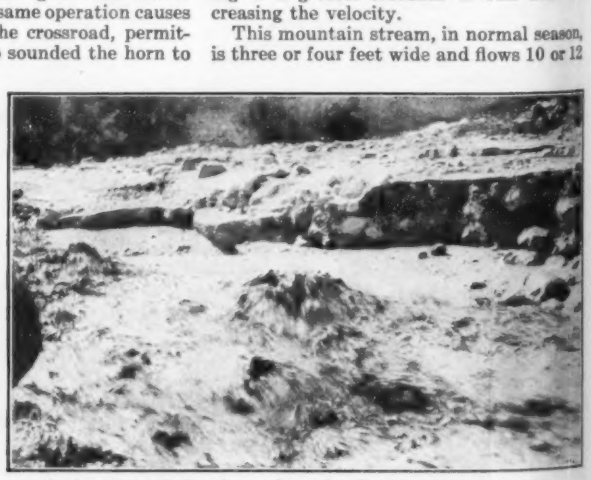
The river of mud develops after a long dry season, out of a large glacier on the southwest side of Mt. Shasta in northern California. The glacier is located about 1000 feet above the timber line and is one of the few patches of snow and ice left on the mountain by late summer. The face of the glacier is about 175 feet high by 400 feet wide, and it lies in a deep crevice of undetermined depth.

A dry season will cause the glacier to begin to disintegrate. The excessive runoff brings with it rocks, and it picks up a large amount of volcanic ash on which the glacier appears to be resting. This muck finds its way through a gorge, the banks of which are more than 1000 feet high, and on its way to the lower levels it mixes with a free flowing stream of pure mountain water which dissolves the glacier flow, giving it a greater freedom of run and increasing the velocity.

This mountain stream, in normal season, is three or four feet wide and flows 10 or 12



Volcanic ash, rocks, and other debris deposited by the river of mud which flows down from Mt. Shasta after a dry summer, has killed many trees, as shown here



A close-up of the river of mud. It frequently changes its course, leaving stretches of ash and rocks where it formerly ran. In the background is a former course

miles to the McCloud River which, in turn, empties into Sacramento River. When the sun has had its full effect upon the glacier, however, the stream becomes 12 to 15 feet deep and spreads, seven or eight miles from its origin, to a width of a mile to a mile and a half.

The greatest volume of flow of the river of mud is at two or three P.M. and at night the mud flow stops. A unique feature of the situation is that due to the solidity of the material flowing, which is estimated to be about 90 percent solid, large boulders will float along like wood. These boulders and other debris settle at times and pile up in narrow places like an ice jam. Such a blockade will hold for several hours and then, without warning, will let loose and send forth a flood of rocks, ash, and sand.

Engineers have been building dams and endeavoring to divert the flow into new channels so as to protect the McCloud River Railroad and other property. Many of their dams have been washed out, but now they have erected a barrier so that a large mountain valley will be used as a settling basin.

The engineers have found that the entire country seems to be of mud flow formation to a great depth. Well drillers in the town of McCloud have found mud flow formation to a depth of 300 feet.

During the late summer when the mud flow is at its worst, the volcanic ash finds its way into the McCloud River, thence into the Sacramento and into irrigation ditches and canals. The ash is of such light content that it does not readily settle and has caused a discoloration of the Sacramento River for almost its entire length. Stretches of the McCloud River Railroad have been raised from time to time to protect the roadbed from the mud flow.

Collecting Fossil Mammals From the Pampean Formation

ONE of the famous localities where the fossil remains of extinct animals are found is in the great plains region of central Argentina. Beneath the soil of this fertile plain are found the skeletons of fossil mammals which rival in size those of the mastodon and mammoth of North America. The existence of these fossils has been known since the time of the earlier settlements in Argentina. They are encountered about the shores of lagoons, along the banks of rivers, and are sometimes turned up by dredging when making river channels and harbors deeper for better navigation.

The Second Captain Marshall Field Paleontological Expedition to Argentina and Bolivia, has recently returned to Field Museum of Natural History, Chicago, from a series of fossil-collecting trips which covered many parts of Argentina and Bolivia. Among the localities visited by the collectors of this expedition was the Central Pampa region.

In most instances the skeletons of the great pleistocene mammals were found along the courses of rivers. The action of high waters, which lay bare, year after year, the strata of sands and clays in which the fossils are embedded, greatly facilitated the search. As the banks are worn away the fossils are continually being washed out, and hence their discovery is made possible.

In like manner the southern coast of the province of Buenos Aires has long offered a favorite collecting ground for such specimens. For ages the sea has been continually cutting away the land there. Every period of storm and every high tide has added to this work. Rock ledges of similar age and formation to those seen farther up the courses of rivers are being worn away by these agencies, and their exposed sections are left standing in a series of abrupt cliffs facing the sea. For many years visitors to the seaside resorts have been attracted by the pieces of fossil bone which are found broken up and mingled with the beach-gravels. Also, many notable specimens have been found in the sea-cliffs by scientific collectors who carefully watch these shores.

Specimens collected by the Captain Marshall Field Expedition in the Pampean formations include the shells of the armored mammals, glyptodonts, skeletons of such of the great ground sloths as megatherium, glossotherium and scelidodon, and less complete specimens of the South American species of mastodon and of the great saber-tooth tiger, machairodus. These specimens will not only enrich the collections of Field Museum, but will aid in the study of the extinct animal life of the South American continent.—*Written especially for* SCIENTIFIC AMERICAN *by Elmer S. Riggs, Associate Curator of Paleontology, Field Museum of Natural History; leader, Second Captain Marshall Field Paleontological Expedition to Argentina and Bolivia.*

Pelvis and other bones of southern mastodon found in the Pampean formation by the Second Captain Marshall Field Expedition to Argentina

Sectional Concrete Forms to be Used Many Times

THE sections of the forms used in the construction of concrete piers to serve as foundations for steel transmission towers of the Commonwealth Edison Company were so constructed that they might be used over and over again. These forms were pulled

Curved sections of the forms used in constructing concrete piers of foundations, were lifted, after the concrete had set, by using block and tackle and a tractor

It was a simple matter, after the sectional forms were raised from the foundation, to move them by sliding to the location of the next tower. A tractor did the work

from place to place by a tractor and the same tractor was used in pulling out the forms after the concrete had set.

Further Nuptials

IN our April issue we ran a chemical note entitled "Celluloid-Rubber Nuptials," about which we have received quite a number of inquiries. Mr. Giles Law of the Newport Chemical Works, Incorporated, Passaic, New Jersey, writes us concerning the article as follows:

"In fairness to them (our readers) and to ourselves, you should know that not hexalin but the esterification of hexalin, known as hexalin acetate, is the only 'parson' who is eligible to unite this odd couple. The progeny, no black sheep by any means, is already doing its part of the world's work in the manufacture of artificial leathers, lacquers and finishes, water-proof coatings, and such similar products.

"We call this to your attention because as a result of magazine articles we receive a large number of requests for samples and many of them do not state the exact purposes for which those samples will be tried out. You can, therefore, readily see that on requests resulting from your article we would be sending a clergyman who was incapable of performing the ceremony."

The correction of the marriage record is gladly placed before the public.

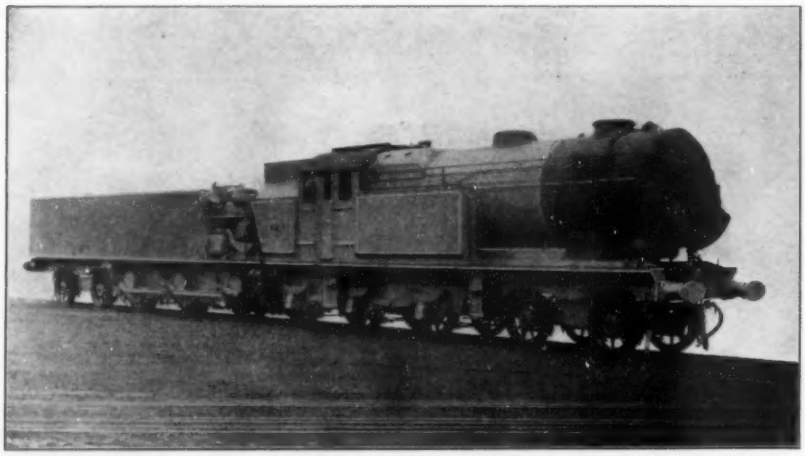
2000-Horsepower Ljungström Turbine Locomotive

FOR the past few months there has been running on regular schedule on the London, Midland and Scottish Railway, a 2000-horsepower Ljungström locomotive built by Beyer, Peacock and Company, Limited, Manchester, England, which embodies several improvements over the first locomotive built with this type of drive, which is itself quite new. This newest locomotive was built for express passenger service, and has a maximum speed rating—with English trains—of 75 miles per hour. It has, however, already made more than 76 miles an hour, and is believed to be capable of making 80 miles an hour.

The locomotive consists of two sections, the first of which constitutes the boiler plant, and that following—ordinarily the tender—makes up the driving section and contains the turbine, the condenser, and the reduction gearing. The coal bunker is immediately behind the engineer's cab, while the water is contained in two side tanks and in the condenser tank.

Total length of this locomotive over the buffers is 73 feet, 11 inches. Loaded to its capacity of six tons of fuel and 1950 gallons of water, the engine weighs over 143 tons, of which over 54 tons are available for adhesion.

The boiler is of the Belpaire type and was designed for a working pressure of 300 pounds per square inch. The heating surfaces of the tubes is 1480 square feet while there is an additional heating surface in the firebox of 140 square feet.



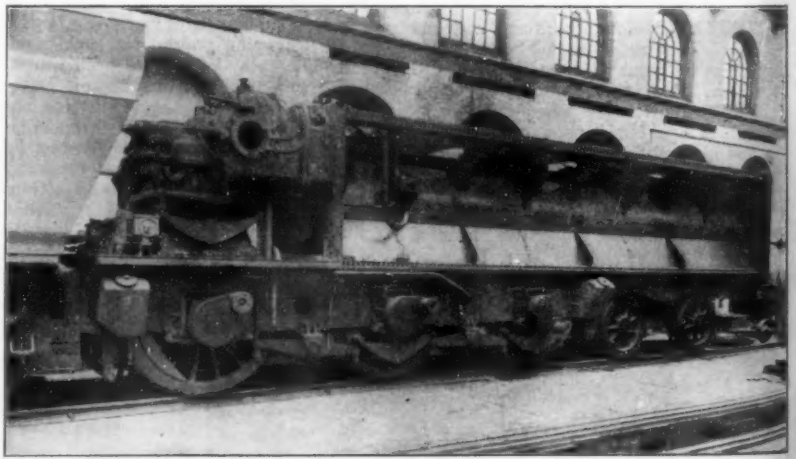
The new 2000-horsepower Ljungström turbine locomotive built for the London, Midland and Scottish Railways—second of its kind to be built

The driving turbine is of disk and drum type, the rotor of which has a single row impulse wheel at the high-pressure end and 18 rows of reaction blading. The rotor was designed for 10,500 revolutions per minute maximum, corresponding to 75 miles per hour or 2000 brake horsepower at full steam pressure. The torque is transmitted to the leading driving axle (the leading axle of the "tender") through triple-reduction gearing, and, in turn, to the other two driving axles by floating driving rods.

Since the steam is condensed and can not be used to create a stack draft, a turbine-driven air fan was installed on the front of the smoke box. Louvres at the extreme forward end of the box admit air for the turbine which runs at 28,000 to 30,000 revolutions per minute; these louvres being interconnected with the firing door in such a way that the latter can not be opened unless they are completely closed.

Although this locomotive is very powerful, it is said to consume less fuel than the standard locomotive, and is capable of running long distances without taking on more water. Even in a country where the railroads are plentifully supplied with track tanks, this is a desirable feature since it allows a choice of feed waters and may thus materially reduce boiler cleaning.

Another noteworthy characteristic of this locomotive is the large starting torque of its power unit, since the starting torque of a turbine is just double that developed by it at maximum efficiency. There is no dead center to a turbine and a locomotive equipped with one will not have to back up in order to make a forward start as is so often the case with English trains.



Driving unit of the Ljungström locomotive uncovered to show turbine and condenser. On an ordinary engine this unit would be the tender

Arc-Welded 45-Mile High-Pressure Pipe Line

RECENTLY, the longest electric arc-welded pipe line in the world was completed between Lamkin, Louisiana, and Hodge, Louisiana—a distance of 45 miles. It is seven inches in diameter throughout the entire run and carries from 600 to 1000 pounds pressure.

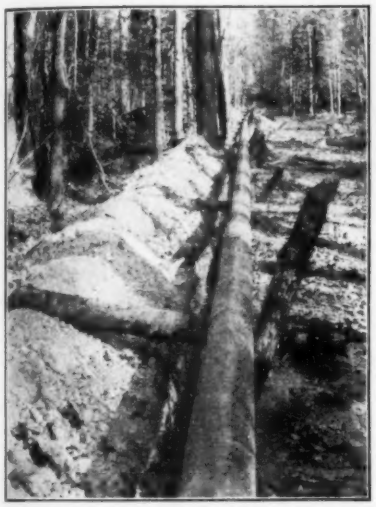
The line was welded by The Big Three Welding and Equipment Company of Houston, Texas. For several years prior to the building of the line, Mr. Smith, president of this company, had been working experimentally on pipe line welding with the thought in mind that some day he would be called on or permitted to construct a line in that fashion.

The lowest bid the owners got for welding the Louisiana line by the oxy-acetylene method was $2.75 per joint. Mr. Smith's bid, the only one submitted for electric-arc welding, was $1.25 per joint.

The country over which the line ran was very rugged and broken. There were hills, deep ravines, woodlands, and swamps. There was even a river to cross. Despite

these physical obstacles the line was laid without difficulty. A total of five gas engine driven welders, manufactured by The Lincoln Electric Company, Cleveland, Ohio, were used. In doing the work in the field, the welders, of course, operated as a team; that is, four men simultaneously welded four consecutive joints and moved on. The lengths thus formed were joined together by a bell hole operator.

The line was built in five mile stages, each stage being finished and tested under hydrostatic or gas pressure before further pipe was laid. The joints were all made in two layers and it is interesting to note that with this construction, which was developed by



Section of the 45-mile high-pressure pipe line that was successfully electric-arc welded

Mr. Smith, only 14 pin holes occurred in 11,000 joints.

On December 15, 1927, the pipe line was finished, in the ditch, and ready for the final covering of earth. Two weeks later, when 20 miles of the line was still uncovered, a northwestern storm swept Louisiana and the temperature dropped to six degrees below zero—the lowest temperature the state had known for 30 years. It had been the belief of pipe line men that a line built during warm weather would, if left exposed, break due to contraction stresses. This line, however, withstood the strain and not a sign of failure occurred in the 20 miles that was exposed to the weather.

Expert welder sealing a pipe line joint by the arc-welding process. Current was generated by a new apparatus comprising a gasoline motor and the generator which it drives, developed by the Lincoln Electric Company, Cleveland

Where Do Old Tires Go?

AN innovation in modern footwear is found in Greece, Macedonia, and Thrace, where discarded tire casings are converted into shoes, supplanting the leather *tcharik*. A shoe made from an old tire is good for 10 or 12 months of wear as compared with less than three months for *tchariks* made of hide. Economy and better protection from winter dampness have given the new footwear universal popularity among the Macdeonian peasants and villagers.

The demand is so great that the local supply is insufficient and the imports of used casings amount to 50,000 a year. Each casing yields three pairs of shoes, selling for about 50 cents a pair. The imports come from France, and a generous proportion of the old tires thus brought in finds use on motor vehicles before reaching the shoe factory. In Mexico, also, there is widespread use of old tires for footwear. The custom of the Mexican peon is to cut a piece of rubber to fit the sole of his foot, and bind it to the foot by means of leather thongs.

One of the shoes made of old tires, described in the accompanying article. It is interesting to note how straps are attached and the toe drawn in

New Three-Power Locomotive

A NEW battery-oil-electric locomotive, carrying its own power plant and the first of its kind ever built, was recently tested in New York by the New York Central Railroad for which it was constructed for service in freight yards which are not completely electrified and where part of the time it is required to operate through city streets.

As this new locomotive will be required to operate at times over tracks which are electrified, third-rail shoes are provided, together with an overhead collector. This permits the operation of the traction motors from external sources of supply when in electrified districts.

The new locomotive, which weighs 128 tons in working order, is a product of designs by the New York Central's electrical engineering department working in combination with the General Electric Company and the Electric Storage Battery Company, and was built by the American Locomotive Company.

When the locomotive is operating in the non-electrified sections, the power is furnished by a storage battery of 218 cells weighing 17 tons, one of the largest batteries ever used for locomotive service. The battery is charged by a 300-horsepower Ingersoll-Rand oil engine, connected directly to a 200-kilowatt General Electric generator. This is so designed that, if it is operated at the same time that power is being supplied to the traction motors, it will divide the load with the storage battery in periods of heavy output without overloading the engine and will return automatically to charging the battery as soon as the load has decreased. The battery supplies the surges of power required in switching service when a locomotive must respond quickly.

The locomotive, which is 46 feet, eight

inches long over the couplers, is a swivel truck type with a cab in three sections, the batteries being carried in the end sections and the oil-engine in the central section. The batteries are arranged in tiers. The central section of the cab, in addition to the power plant and control apparatus, has two small operating compartments for the enginemen. There are doors giving access to each operating compartment from the outside and to the power plant from the operating compartments.

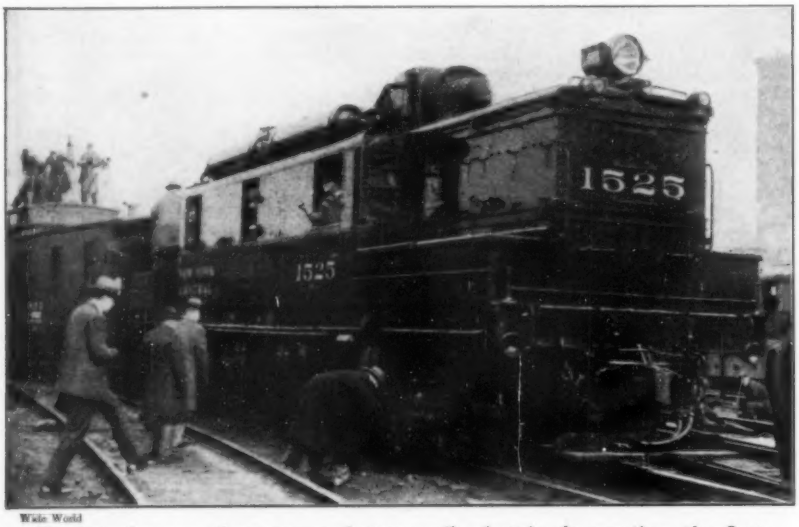
In the roof of the central compartment, directly above the oil engine, is a hatch permitting the removal of the engine if necessary. The locomotive is equipped with four 600-volt, single-geared traction motors each of 415 horsepower. Control is non-automatic with individual electro-pneumatically operated contactors and the locomotive may be operated from either end.

There are four methods of operation: from the storage batteries alone; from the storage batteries and engine generator together; from the third rail; and from an overhead collector. As the change-over from external to internal power supply, or vice versa, occurs automatically, indicating lights are provided in the enginemen's cab to show under which condition of operation the equipment is running.

The locomotive has unusually complete metering equipment in order to assist the engineers in studying its utility for service and determining what modifications, if any, should be made for future locomotives of this type.

Fuel tanks, having a storage capacity of 200 gallons of oil, are provided. These are sufficient to operate the engine at full load for about 10 hours. The engine is run at constant speed under control of a governor.

The locomotive will be tested in actual operation in the west-side freight yards of the New York Central Railroad in New York City.



Wide World

Testing the new three-power—battery, oil, electric—locomotive, the first of its kind ever built, in the west-side freight yards in New York City

Indians Slow But Sure

THE red man is rapidly taking over the white man's civilization, but he has not tuned himself up to the speed of present day America. This is indicated by mental tests given to 120 Indian children on the Yakima reservation, state of Washington.

Results of the test, just reported to the *Journal of Abnormal and Social Psychology* by Otto Klineberg, of Columbia University, show that in tests where the children were to fit together the pieces of a puzzle, the Indian children averaged 11 moves in a minute as compared with 17 moves a minute by white children.

"In extreme cases the difference is striking," Mr. Klineberg said. "The white boy jumps at the puzzle. He tries the pieces here, there, everywhere. When he strikes at what seems to be its proper place, he leaves it there, and flies to the next. He completes the test in 66 seconds, but he has made 14 errors in the process.

"The Indian boy moves slowly, deliberately. He seems to think each move twice over. You have said to him also 'as quickly as possible,' but that evidently means little to him. He takes 137 seconds to complete the tests. A poor performance, apparently, but he has not made a single false move."

Dr. Klineberg is now investigating whether white children would improve in accuracy if they imitated the Indian child's deliberate manner.—*Science Service.*

Special Machine Salvages 70 Lines of Copper Wire

FOR the purpose of salvaging 70 lines of copper wire, which were replaced by a modern toll cable between Berkeley and Crockett, California, a special winch was developed by the telephone company and mounted on a tractor. The winch is equipped with a reel at each end, thus permitting two rolls of wire to be wound up at one time. Each of these outside reels is made with a bevel which permits easy removal of the wire from the reel, no matter how tightly it may be wound. The reel has an outside flange which is removed when the coil is ready to come off.

About three quarters of a mile of wire was wound at one time. The average amount of copper wire salvaged per day with this outfit averaged from 3000 to 5000 pounds, and this was over a country which was particularly broken, consisting of high hills with very steep hillsides.

An interesting feature was the fact that the tractor was equipped with two arms to which was attached a pair of scales for the

Reels, attached to the rear end of, and driven by, a tractor, made possible the salvage of 70 lines of valuable copper wire. Weighing arm is shown in front of driver

After the wire was reeled in, the flange was removed from the reel, and the wire roll easily slipped from the tapered hub. The tractor then hauled loads of wire to the trucks

weighing of each coil before being placed on the trailer which the tractor transported to a point where trucks could negotiate.

Tropical Sun Keeps Babies Well

THE only case of rickets that experts from the United States Children's Bureau found in a recent survey of 600 Porto Rico babies was in an infant that had spent five of its six months in a cellar lighted only by electricity.

The survey was undertaken under the direction of Miss Grace Abbott, chief of the bureau, to determine the effect of the tropical sun on rickets, the disorder of the mineral chemistry in the bodies of young children that is prevented by the action of ultra-violet rays. It is especially desirable, Miss Abbot pointed out, to have a series of X-ray pictures of the bones of babies who live in the tropics because they normally spend most of their waking hours with their little bodies completely exposed to the beneficial action of the sun. The photographs will be used to compare with those of children in temperate climates so that some sort of a standard can be obtained of what the healthy bones of a growing child should look like.—*Science Service.*

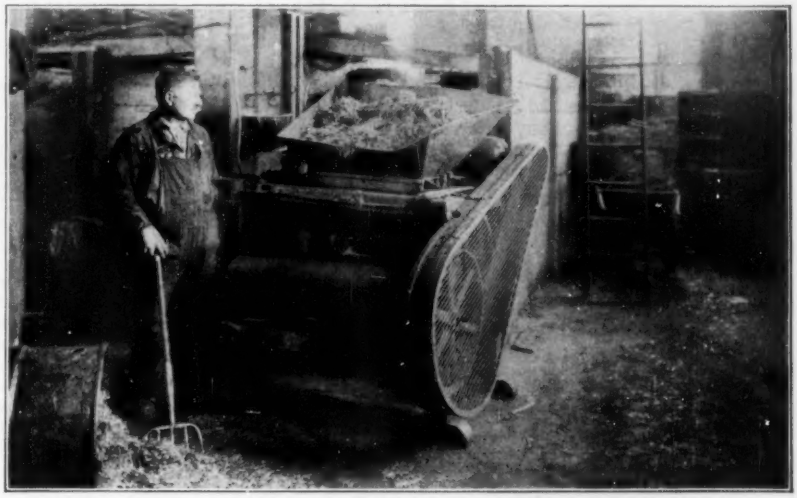
Magnetic Device Separates Metals

BY the use of a magnetic device for separating iron and steel from monel turnings when mixed, the General Electric plant at Schenectady was able to save approximately 20,000 dollars annually in the disposal of its scrap.

Approximately 70 gross tons of mixed metal turnings were scrapped each year, as no method was known of separating the high-value monel from the lower-value iron and steel. Mixed metal turnings were sold for an average price of 15 dollars per gross ton, while clean monel-metal turnings brought approximately 300 dollars per gross ton.

Many methods for separating the two kinds of scrap had been tried without success, including the use of magnetism. The magnetic method was not successful because the monel metal was also picked up by the magnet. Finally, by using a rheostat on the magnetic separator and reducing the current to a minimum, a point was reached where the iron and steel were picked up and the monel metal dropped.

During the cold weather, a clean separation was difficult because of oil congealing on the turnings and holding the two metals together. One of the plant workmen suggested that the turnings be dried on large steel plates with fires beneath. This was tried and was found to be successful.



Monel-metal turnings are separated by this machine from iron turnings which have a lower "scrap" value. Its use effects a large saving

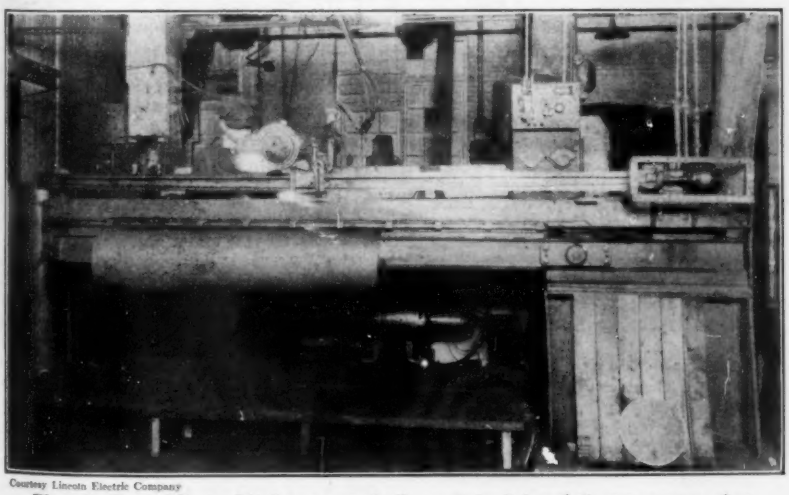
Welding Pressure Containers

WHEN welding first began to compete with riveting in structural work, there was considerable difference of opinion as to just how trustworthy this method would prove in pressure work such as, for example, pipe lines. Several very interesting long distance pipe lines have been successfully welded within a recent period, although in one case, it will be recalled, failure took place under unusual conditions of size, location and method of installation. It will be profitable, therefore, to note a further advance in pressure work as shown by one of our illustrations.

This illustration depicts an automatic arc welder for welding range boilers, designed to meet the particular needs of the producers of range boilers due to sharp competition. While large numbers of range boilers are produced, the price the manufacturer gets for the boilers is very close to his actual production cost. Under such conditions the use of high speed automatic machinery by the dominating factors in the industry, usually solves the problem.

On 14-gage steel the automatic carbon-arc welder makes a speed of 150 feet per hour at a cost of slightly over one cent per foot of longitudinal seam. The cost per foot on the head seams is somewhat less than on the side seams. The side seam is welded with a filler rod which is laid on the seam and fused into the joint by means of the carbon arc. Water-cooled copper guards confine the arc to the seam.

The range boiler is slipped on to the mandrel of the machine and the top clamps are lowered in order to hold the seam in position. The clamps also carry the upper rail on which is mounted the carriage for the automatic welding head. To weld, the operator merely starts the arc in operation and the motor-driven head is carried along the seam, fusing the filler and the edges of the seam together.



Courtesy Lincoln Electric Company

Electrically welding a kitchen range boiler. It is claimed that great speed at low cost can be made on such pressure containers as the one illustrated

Geophysical Prospecting

ELSEWHERE in this issue we publish the second of a series of articles covering the several methods of geophysical prospecting for minerals. The following list of companies engaged in this work and in the manufacture of the requisite apparatus, is reproduced, with permission, from the March 24, 1928, issue of *Engineering Mining Journal* (New York).

Exploration Companies

Swedish American Prospecting Corporation, 26 Beaver St., New York.

Schlumberger Electric Prospecting Methods, 25 Broadway, New York; also 62 Front St. West, Toronto, Canada.

The Taumac Corporation, 342 Madison Ave., New York, N. Y.

The Radiore Company, Hollingsworth Building, Los Angeles; and 96

(*Please turn to page* 563)

Strays From the Ether

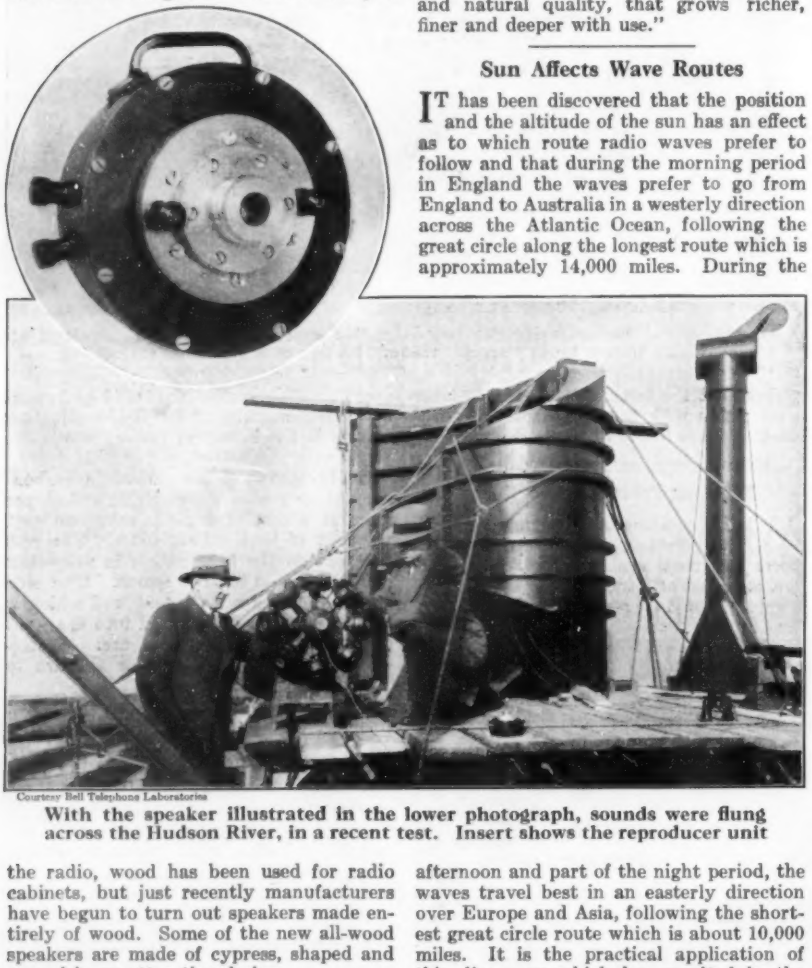
A Monthly Review of the Progress Made In All Branches of Radio Communication

Wooden Loudspeaker Horns Return

AN innovation in the radio industry is the all-wood loudspeaker, according to the National Lumber Manufacturers' Association in Washington. Since the infancy of the radio, wood has been used for radio cabinets, but just recently manufacturers have begun to turn out speakers made entirely of wood. Some of the new all-wood speakers are made of cypress, shaped and carved in an attractive design.

"The idea of making a radio speaker from wood was conceived by men who realized that wood, free from any metallic quality, was obviously the best material for an instrument of this kind," E. Dalman, one of the manufacturers of the new type speaker explained. "Phonograph makers have long known that by far the best sounding-box for their product is that made of wood, and the radio loudspeaker is equivalent to the phonograph's soundbox.

"The use of wood has the same effect as in a violin, eliminating vibration and enabling every note from the deepest bass to the highest range of the violin, and from the faintest whisper to a crashing torrent of sound, to come forth free of distortion. Even static is subdued by these soft tonal qualities. The harsh metallic rattle, the snapping, crackling disturbance is smoothed out and toned down by the vibration-resisting wooden walls of the all-wood loudspeaker. And, again like a violin, the longer the wood speaker is used the better the tone becomes, as the wood gives to sounds a live, ringing and natural quality, that grows richer, finer and deeper with use."



Courtesy Bell Telephone Laboratories

With the speaker illustrated in the lower photograph, sounds were flung across the Hudson River, in a recent test. Insert shows the reproducer unit

Sun Affects Wave Routes

IT has been discovered that the position and the altitude of the sun has an effect as to which route radio waves prefer to follow and that during the morning period in England the waves prefer to go from England to Australia in a westerly direction across the Atlantic Ocean, following the great circle along the longest route which is approximately 14,000 miles. During the afternoon and part of the night period, the waves travel best in an easterly direction over Europe and Asia, following the shortest great circle route which is about 10,000 miles. It is the practical application of this discovery which has resulted in the construction of the Australian transmitters and receivers so that transmission and reception can take place in either direction as required.

Short Waves Recommended

A PROSPECTIVE radio set owner in Peru writes that he has done nothing with radio before, but "since the monopoly has dissolved, I would like to have a receiver to pick up programs across 4000 miles," and he wonders how to erect an antenna to receive well from both the United States and the Argentine.

The best plan would be to get a good short-wave receiver using three tubes. It will pick up the broadcasts from Pittsburgh, Schenectady, and from many other short-wave stations. Get a set of coils for the receiver covering the waves from 15 to 100 meters. A short-wave set in Peru ought to produce most interesting results from all parts of the world. For reception from the United States, point the wire in that direction and take the lead-in off the end that points toward the country from which best reception is desired.

The Fading Area

CONCLUSIONS based upon the observations made by a corps of experts who tuned in special high-power broadcasts from WGY, Schenectady, and KDKA, Pittsburgh, reveal that listeners located within the radius of 60 to 125 miles from a transmitter hear fading at its worst. The results were tabulated by the Bureau of Standards.

Seeking New Methods

RAPID strides are being made by two large research laboratories in the development of an improved method of broadcasting, which will enable better quality and narrower wave bands in broadcasting. This means that interference will be minimized. There will be room for more stations and fewer tubes will be required at the sending end.

Trend Toward Electric Receivers

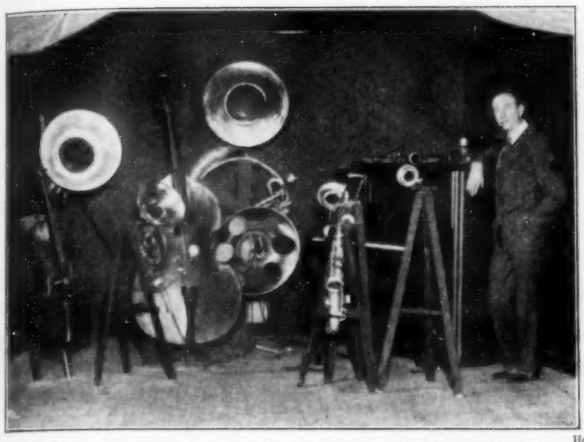
THE greatest demand for the 1928 radio season is for custom-built receivers equipped for complete electrical operation. The tendency is toward the use of high plate voltages and one of the characteristics most in demand is realistic reproduction.

Radio On Freight Trains

SEVERAL times in this department, we have spoken of experiments in connection with moving trains and radio communication. A recent test of radio transmission and reception on board a mile-long freight train has been highly successful. Throughout a 95-mile trip, the conductor in the caboose and the engineer in the cab were in constant communication. There was no aerial interruption whatsoever. The communication did not interfere in any way with the regular duties of the train men.

Not only was communication carried on between the caboose and cab, but contact was made with the signal tower at South Schenectady when the train was still eight miles away. A wavelength in the band of 109 to 130 meters was employed and it was found that this wave set up no interference with broadcasting or other radio reception, and it was also noted that no other service in any way interfered with the train communication.

The apparatus used in the test was extremely simple and there were no adjustments left for the train men to make. The equipment was tuned before the train left the terminal and was then sealed. It re-



A phantom radio-orchestra has been developed by W. Dexter Smith, wherein a reproducing unit is attached to each instrument as shown, and the instrument responds to the sound vibrations only when a similar instrument is played at the broadcasting station

Herbert

Here is the radio receiver which connects to the phantom orchestra illustrated at the left. It is reported that those who have heard the music reproduced by the combination state that the results are better than obtainable by any single loudspeaker connected as is usual

quired no attention during the trip. The transmitter was started and stopped automatically by the simple action of taking up and laying down the hand telephone. The transmitter used three 50-watt tubes and one 7½-watt tube. Four of the latter were used in the receiver.

Radio Operators' Hobbies

SIMILAR to the much-talked of postman's holiday is the instance where five of the engineers of station KOA, in Denver, have radio for their hobby. These five men own and operate amateur stations during their leisure hours.

Airplanes Directed By Radio

RECENT tests at Mitchell Field, Long Island, indicated the possibility of directing aircraft in battle by means of radio. The recent maneuvers embraced several flights of a five-mile span and at all times the ground officials were in communication with the pilots.

Radio on Airplane Carriers

AN unusual problem in radio engineering was presented in the case of the U. S. S. *Saratoga*, national airplane carrier recently launched at Camden, New Jersey. Inasmuch as the ship carries 83 airplanes, and the upper deck is virtually a flying field for them, there must be no stray wires which would be in the way of the planes.

Unhampered operation of aircraft when taking off or alighting, therefore, makes it necessary to clear all aerials from the flying deck on the port side. All transmitting aerials are suspended on the starboard side of the smokestack, the main one to starboard of the smokestack from the after end to the single topmast. Facilities are provided to lower the latter when passing under Brooklyn Bridge.

The *Saratoga's* main transmitter is more powerful than that of any other naval vessel except its sister ship, the airplane carrier *Lexington*, which is similarly equipped. Being plane carriers, both ships will be used for scouting duty, necessitating long-distance communication with the commander-in-chief.

Several other transmitters of various power will have particular duties, and transmission and reception in several different channels without interference will be possible. Radio compasses for obtaining bearings of planes on scouting duty to guide their return to the carrier are included.

A Fight Wins!

"WHAT do listeners enjoy most on the radio?" Perhaps you would answer: "A prizefight." "Probably you'd be correct," says Kolin Hager, studio manager of WGY.

Radio Poor in Middle West

THE officials of station WOC, of Davenport, Iowa, are considering the possibilities of installing a 50-kilowatt transmitter. In commenting on the present radio situation in the middle west, Frank W. Elliott, manager of station WOC, said:

"We feel that the work of the Federal Radio Commission has helped some, but conditions will not be what they should until the better-grade stations have exclusive wavelengths, with high power and proper geographical locations to avert interference. Today, Santa Monica, California, interferes with WOC, because both are on the same wave. WEAF, New York, when it reaches the mid-west, intermingles with KGW, Portland, Oregon. There is a low beat-note growl on WJZ's wave when it reaches Iowa. WOR, Newark, is generally clear. WGY, Schenectady, is clear. We never hear WNYC, New York.

"Station KFI, Los Angeles, is the ace of the Pacific Coast as far as reception in Iowa is concerned, while the most consistent reception from the east comes from WEAF and WJZ, except for the heterodyne howl on WEAF. WOR's signal strength is generally less, but the quality is good."

Radio-Phone Service To Belgium

THE latest link in the radio-phone circuit of the American Telephone and Telegraph Company with Europe is between the United States and the Belgian cities of Brussels and Antwerp. Remarkable clarity of transmission is said to characterize the service.

P and A

A device to insure secrecy in radio telephone transmission was recently demonstrated before the Engineers' Society. In the device, part of which is illustrated, the sounds are converted into gibberish at the transmitter, sent through space by the usual method, and translated at the receiver. This prevents the ordinary listener-in from obtaining information

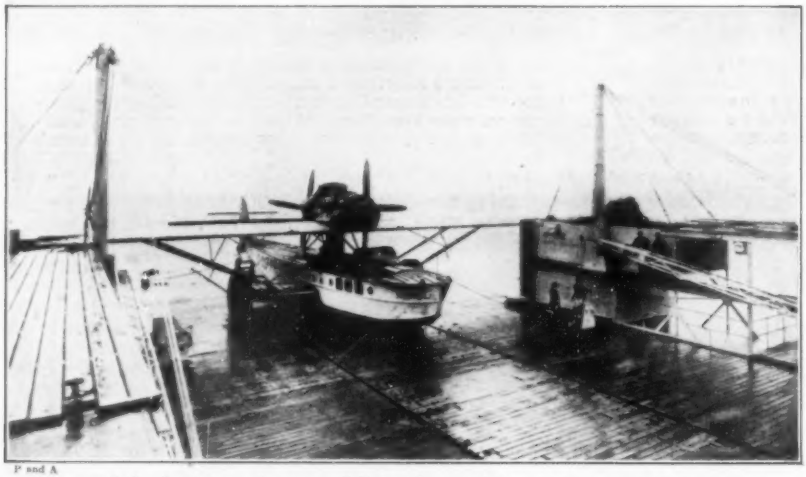
Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

Airship Design and Fallacies

AIRSHIP design is a highly specialized art, with few exponents. As a result, authoritative texts on the subject are rare.



P and A

Many of the large seaplanes and flying boats that are in use to-day present difficulties when repairs are necessary. In cases where the planes are too large and unwieldy to beach for overhaul or the like, it is quite obvious that a dry-dock is necessary. Such a dock has recently been constructed by the Luebeck Flendor Works of Germany. The photograph directly above illustrates this dock with its first arrival for service, the Dornier *Super-Wahl*

We welcome C. P. Burgess' book, "Airship Design," published by the Roland Press of New York. It covers in impeccable fashion such subjects as size and performance, aerodynamic forces, the strength of nonrigid and rigid airships, gas pressures and forces, and steps in design.

Apparently in self defense the author classifies, in the last chapter of the volume, six fallacies which have caused inventors to waste much effort in the past, and which may yet induce many misdirected efforts. The fallacies which Mr. Burgess lists are: the vacuum airship; compressing gas or air for ballast; artificial control of superheat; combined heavier and lighter-than-air craft; channel through hull to reduce resistance; wind screen at mooring mast.

The vacuum airship fails because when a thin metal shell of the length of the *Los Angeles* is exhausted of all gas, the pressure at the ends is of the order of hundreds of thousands of pounds. Nothing can prevent longitudinal buckling.

The compressing of gas from the cells into high-pressure containers is enticing, because apparently no ballast need be carried. And when the buoyancy of the airship is to be decreased, no gas need be lost. It is simply withdrawn from the gas cells and compressed into special containers. The impracticability of the device lies in the fact that a steel flask weighing 130 pounds only holds 180 to 200 cubic feet of gas compressed to 2000 pounds per square inch, and the lift of this gas, when released, is only 10 percent of the weight of the container. The containers, to be effective, would weigh more than the entire weight of the rest of the airship!

The artificial control of superheat breaks down because to cause any permanent variation in the internal temperature of the gas, an absolutely prohibitive amount of heat must be supplied. Only by making the gas cells impervious to heat conduction is there any hope of success.

One of the most frequent of suggestions is in the combination of planes and airship hull. Here we may let Burgess speak for himself. "The combination craft is heavier than air, and depends, therefore, upon the power of its engines to keep it aloft. It must leave the ground and alight at high speed, because the lift of the planes is proportional to the square of the speed, and at low speed they would afford no appreciable lift. All these disadvantages the combination craft shares with the airplane. But on the other hand, because of the great bulk of its gas-filled hull, it is not a handy and easily maneuverable craft like an airplane. It is impossible to conceive a large airship running at high speed along the flying field before taking the air; and still less would be possible to construct an airship capable of sustaining the shock of striking the ground at high speed when landing."

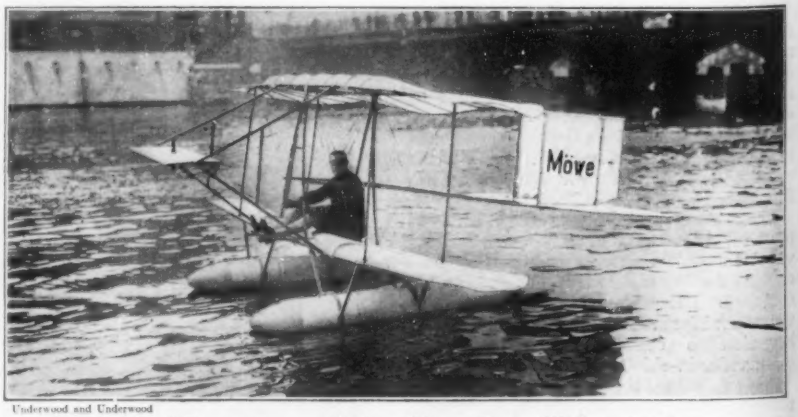
Channels through the center of the airship to reduce resistance sound attractive, but they actually increase resistance instead of diminishing it.

Perhaps the reader himself has been guilty at some time of one or other of these conceptions!

A Hydro-glider

REPORTS from Berlin claim that the *Möwe*, a glider constructed by Hans Richter, is the first hydro-glider ever built. As a matter of record, the great pioneer Glenn L. Curtiss has the distinction of trying out the first hydro-glider at Port Washington, Long Island, in 1923 or 1924. Richter has in his design shown much ingenuity in keeping down weight. Thus the pontoons are merely air-inflated bags; there is no fuselage, but merely outriggers in front to support the horizontal control surfaces, and outriggers in the rear to carry the rudder.

The idea of a hydro-glider has a certain fascination. Nothing would seem a more pleasant sport than to have a motor boat pull a glider through the water until sufficient flight speed is attained, and then to skim over the water in perfect safety. The difficulty is that with land gliders certain geographical locations can easily be found where a steady up-wind may be reckoned upon, whereas such conditions are not so easy to find over water. Land and sea



Underwood and Underwood

The *Möwe*, a German hydro-glider with air-filled pontoons

breezes might be powerful enough, yet not have the necessary upward component.

Combination Pontoon and Ski

A. R. STALB, of the Fairchild Airplane Manufacturing Corporation, has designed a very ingenious combination pontoon and ski which will permit flying boats, or more probably seaplanes, to land either on water or on snow-covered land. The seaplane is provided with somewhat larger pontoons than for usual service. The undersurface of the pontoon is of extra heavy gage duralumin and it has the ski unit as an integral part shaped to the contour of the keel. The ski is hinged at its forward end to a bracket on the bottom of the float and its rear end is mounted on two shock absorbers.

The shock absorber unit consists of two columns of rubber disks in compression, recessed and concealed in a water-tight well built inside the float at the step. On each side of the ski is a vertical sheet to prevent snow from getting between the pontoon and the ski. This vertical sheet or apron fairs in the ski when the shock absorber is in compression, making a sort of housing for the ski. From the forward end of the ski to the nose of the pontoon there is a false ski on the bottom. This tends to continue the ski shape up to the nose, providing a skiing surface should there be an obstacle in the path of the pontoon.

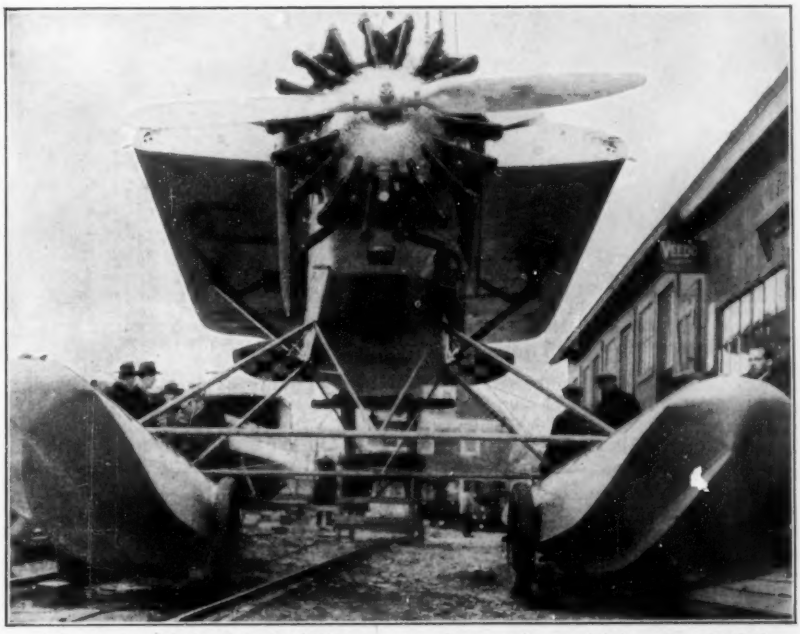
A Fool-proof Plane

CAPTAIN GEOFFRET DE HAVILAND, famous British designer, has recently given a wonderful demonstration of the fool-proof qualities it is possible to obtain in the modern airplane.

When the wing of an airplane meets the air at a big angle, (a big angle of incidence as it is generally termed), the ordinary ailerons become almost inoperative. If the plane is flying at this big angle of incidence, near the "stalling" point, and one wing drops low, the pilot finds that actuating the ailerons does not cause the prompt recovery of normal or low-angle flying. The ailerons do tend to restore the plane slowly to an even keel, but they also have a tendency to swing the plane off its course and to start the greatly dreaded spin.

Metropolitan Photo Service

Mr. Handley Page, inventor of the famous Handley Page slot which has increased safety in aviation



A front view of the Fairchild Wasp-motored monoplane with its wings folded and its combination pontoons and skis lifted from the ground by the beaching wheels. These wheels and their axles are readily detachable when not needed for beaching the water, snow and ice aircraft

But if ahead of the ailerons, at the leading edge of the wing, there is placed the famous Handley Page slot, the ailerons are entirely satisfactory in even the "stalling" attitude of the craft.

The aileron with the Handley Page slot at the leading edge of the wing is particularly valuable from the pilot's point of view, for the slot opens automatically once the danger point is reached.

The action of the automatic slot is readily explained. When the airfoil meets the air at a large angle of incidence the suction on the upper surface of the wing is concentrated at the leading edge of the wing. If at this leading edge we have an auxiliary airfoil, suitably mounted on an articulated and hinged parallelogram, then when the suction is concentrated forward, the airfoil swings automatically forward on its parallelogram.

All reports from Great Britain tend to confirm the fact that the aileron with automatic front slot does eliminate all danger of spinning.

De Haviland, flying his *Moth* light plane, with this automatic slot installed, found that even the most violent backward movement of the stick (intended to "stall" the plane) coupled with lateral disturbances would not produce a spin.

Such a characteristic is particularly valuable when a plane is climbing steeply out of a short field, and the engine fails suddenly, so that a stall results without any error of judgment by the pilot. This characteristic comes in handy in other ways also.

Suppose an inexperienced pilot lands "10 feet above the ground," that is misjudges his height above the ground, and "flattens out" while his wheels are still 10 feet in the air. The machine then drops quite sharply to the ground. In the 10-foot drop we may, with the usual type of control, find one wing tip dangerously low. With the automatic slot, De Haviland proved that such a misjudged landing could be safely made. Some shock, it is true, would be felt, but the plane would maintain a perfectly even keel.

An inexperienced pilot may misjudge his height, by over-estimating instead of under-estimating his height above the ground. In such a case the plane does not flatten out in time, and the nose of the machine strikes the ground straight out of the glide. With the *Moth* in such a maneuver, the nose jerked upwards, the plane bounced off, then sank in a stalled condition, without any sign of loss of even keel, and came to rest practically without a run.

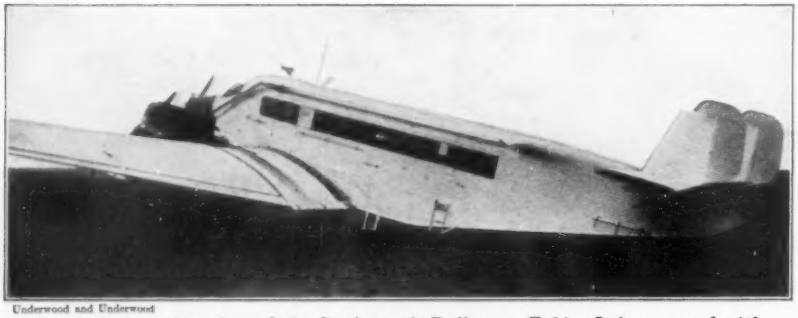
The most striking test however, was that of a stalled glide, from a height of 200 feet. Here the machine was made to glide down, steeply but slowly, and with the nose of the craft well above the horizon. Such a descent is particularly useful when negotiating a small emergency field.

The vertical velocity of descent was about nine feet a second, or roughly half that of a parachute. The craft was under complete control during the stalled glide, but the landing shock was apparently too violent for the fuselage. The undamaged landing gear legs pushed through the cross members of the fuselage. The front portion of the fuselage with the engine, dropped forward. The rear portion dropped backward. In spite of this complete breaking apart of the fuselage, Captain De Haviland was not even scratched.

This is a most remarkable record of what is being achieved in the way of modern fool-proof aircraft.

An Air Pullman

THE Junkers Company, of Germany, has recently tested in a flight from Dessau to Venice, a large three-engined airplane, which is one of the first air-sleepers ever built. The *G-31* is equipped with three water-cooled engines of 400 horsepower each, has a maximum speed of 115 miles per hour, a range of 620 miles with



Underwood and Underwood

A rear quartering view of the Junkers air Pullman, *G-31*. It is powered with three 400-horsepower water-cooled engines and carries 20 passengers

20 passengers on board, and is of 7.7 tons gross weight. The span of the single internally braced wing is 53 feet. The *G-31* is built entirely of dural, with wings, body and tail surfaces all covered with thin sheets of the same material, which not only adds to the strength of the structure, but also gives a good finish to the plane. The pilot's cockpit is just behind the center engine, but the cabin is so deep that there is unimpeded vision above the engine.

The plane is equipped with electric lights and radio sending and receiving equipment. But the most interesting innovation is the division of the passenger compartment into three cabins, each of which can be converted into a four-berth sleeper. The upper berth is a simple hinged affair, which is held in position by a strap and a cable. One of our photographs shows the berths arranged for the night, with a view through the door of the pilot's compartment.

A study of the photographs also will reveal some interesting features in the general design. The fixed horizontal stabilizer and the elevators are entirely above the fuselage. It is therefore possible to bring the tail end of the fuselage to a fine streamline point and thus reduce aerodynamic resistance. Instead of the conventional ailerons, a species of tandem wing is carried at the rear of the main wing, with a carefully designed small opening between the two. Powerful aileron control is claimed for such an arrangement, and when both the secondary wings are turned down, the lift is substantially increased at landing. The center exhaust pipe is carried very far back, so that the passenger compartment is quite clear of the exhaust gases.

"Freezing" on the Controls

NOTHING is so serious for the flying instructor as the possibility of a student "freezing" to the controls in a sudden panic, particularly when the plane is near the ground. Various remedies have been tried. One is to hit the student's head with a fire extinguisher, a spanner or some other handy implement. Another is to have the dual control system so arranged that the movement of a trigger releases the student's control stick from operation. This has the disadvantage of some mechanical complication. A writer in *United States Air Services* describes a novel, simple, and effective device.

An ordinary booster magneto is mounted in the pilot's cockpit, convenient to his hand and free from any obstacles that might prevent its quick operation. An insulated wire runs from the booster into the student's cockpit and up the control stick to the rubber hand grip. Here the insulation is removed from the wire for eight or ten inches, and the wire is coiled around the rubber grip several times, being held in place by two or three narrow bands of tape. When the student "freezes" on the rubber grip in a paroxysm of fear, the pilot switches on the current and the electric shock causes a sudden and happy, (to the pilot) release of the stick.

Wide World

An interior view of the Junkers air Pullman. This was taken from the rear of the cabin, looking forward, past the passengers' berths, to the compartment for the pilot, which is visible through the open door

Anti-knock Pistons

IN high-speed internal combustion engines, particularly those for aircraft use, further progress in efficiency and high power for a given weight depend on the ability to use higher compression ratios without detonation. So far engineers and chemists have sought the solution of the problem by suitable fuels or mixtures of fuels. A Frenchman, P. Dumanois, presented a paper before the Paris Academy of Sciences in which he suggests a radically different line of attack.

The theory is that detonation is due to an extremely rapid wave of combustion, and that anti-knock mixtures do not diminish the temperature of combustion but increase the time necessary for the complete combustion of the fuel in the cylinder.

Dumanois seeks to reduce the violence of the explosive wave by placing obstacles in its path. He employs a piston, as illustrated, where the spark is applied at the lowest of a series of steps. Compression ratios of 6.7 previously attained without detonation only by the use of special fuels, were shown to be quite satisfactory with the use of these steps and ordinary gasoline.

To raise the compression ratio, and still use ordinary fuels without detonation, the piston illustrated above has been designed. The steps reduce the speed of the explosive wave. Spark is applied to lower step

Aerobatics

THE value of stunt flying or "aerobatics" as it is sometimes called, has been often questioned. There is no doubt, however, that training in aerobatics is essential for the military pilot who may, in combat, have to perform the most extraordinary maneuvers. And it may be just as useful for the commercial pilot.

The commercial pilot should not seek any abnormal maneuvers; his job is to fly from one point to another with the maximum regularity and the minimum deviation from a normal flight attitude. But he can never tell when an abnormal condition may be forced upon him. In such a case a training in aerobatics will enable him to resume normal flight attitude in the shortest possible time and with a minimum loss of altitude. Therefore every pilot is interested in aerobatics.

At the conclusion of the war it was thought that the entire field of maneuver had been exploited; yet from time to time other maneuvers are added to the repertory of our fliers. Thus in 1927 Lieutenant James H. Doolittle added the inverted loop to our list. Early this year, a German flyer, Gerhard Fiesler, invented the vertical figure of eight, and Lieutenant "Al" Williams of the Navy has recently capped the exploits of both by performing a horizontal figure of eight.

An ordinary loop is a comparatively simple maneuver. The pilot dives his machine until he attains a high speed, and then pulls back on his stick fairly rapidly. The machine flattens out from the dive, losing comparatively little of its maximum diving speed, passes into horizontal flight for an instant and then, as the stick continues to be held back, climbs on an almost vertical path. At the top of the loop the pilot is flying upside down and then passes into another dive from which normal flight can be readily attained or the loop repeated. The record for the number of consecutive loops now stands over 1100.

During this maneuver, which is illustrated in the first of our diagrams, centrifugal force may be very large. Indeed at

Where will this *grainless* wood be used next?

First produced two years ago. Now standard material in an ever-widening range of industries. New uses being discovered almost every day. Send for large, free sample, and put it to the test yourself!

TILE FOR BATHROOMS

Ever since the dawn of history, man's favorite material has been wood. Surely, it was assumed, this wonderful product of nature herself could not be improved. Yet two years ago, this seeming miracle was actually achieved, and there went forth into the world Masonite Presdwood—a genuine all-wood board that won't crack, check, split or splinter; in fact, a *grainless* wood!

Nor is that all. Presdwood possesses remarkable workability and uniform strength. Very dense and tough, it is also highly resistive to moisture. It has a very smooth, attractive surface on the face side, and requires no paint for protection. It takes any finish beautifully.

Because Presdwood contains no grit or foreign substance, it does not damage tools. It can be used on any woodworking machinery: saw, planer, sander, shaper. It can be cut out, punched, die cut and milled.

And when we say Presdwood is *all wood*, we mean just that. It is genuine wood and nothing else—wood torn apart and put together again.

The first step in the manufacture of Presdwood is to explode fresh, clean chips from guns at a velocity of about 4,000 feet per second. The long fibres thus produced are then thoroughly felted together in heavy mats placed in hydraulic flat-bed presses and subjected to hundreds of tons of pressure. The finished product is trimmed to a four-foot by twelve-foot size.

We don't know ourselves

We don't know ourselves where this grainless wood will be used next; nobody does. Its workability and adaptability are truly astounding. For such things as paneling of all kinds, store fixtures, outdoor and indoor advertising signs, and a hundred and one products of planing mills and woodworking plants, it is already in very wide demand. It is also winning permanent acceptance as the ideal lining for bank vaults, telephone booths, ventilator shafts, closets and trunks. Thousands of feet of it, too, are used in making movies and for incubators, packing cases, tension boards, radio boxes and starch trays for candy factories.

FOR INCUBATORS

But did you know that a contractor out in California is using Presdwood for concrete forms? Did you know that quite a number of boats have been made of it almost entirely? Did you know that it makes an excellent flooring for dance halls and pavilions, and that it is in daily service at the Chicago Art Institute as artist's boards. We certainly didn't—at least until a few short months ago.

* * *

And week after week we hear of new uses! Just recently a manufacturer of bowling alleys became interested in Presdwood. Another unexpected demand is its use as shutters for Dutch Colonial Houses. It is also being made into clothes hampers, bread boxes, patented dairy containers, barbecue stands, bedroom screens and invalid trays.

Where will this *grainless* wood be used next? Nobody knows. For its range of adaptability seems to have almost no limit!

Send for sample—try Presdwood yourself

Users of Masonite Presdwood—and there are now thousands of them!—have found that it often effects marked economies; such as doing away with the expense of painting, reducing the number of manufacturing processes, and eliminating waste in cutting. They have found, too, that it is very easy to work with, and that it is entirely free from knots and other defects.

Why not put Presdwood to the test yourself? It may be exactly the material you are looking for. It may make it possible for you to improve your own product in a number of worthwhile ways or to cut down your operating costs. Or both.

In any event it will cost you nothing to find out. For we will gladly send you a large sample of Masonite Presdwood without placing you under any obligation. Send for it today.

MASONITE CORPORATION

Sales Offices: Dept. 1668, 111 W. Washington St.
Chicago, Illinois

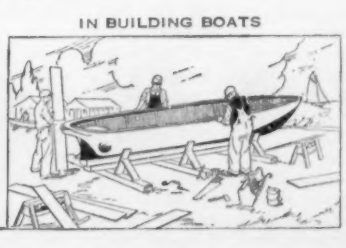
Mills: Laurel, Mississippi

FOR ADVERTISING SIGNS

Masonite PRESDWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

IN BUILDING BOATS



© 1928, M.F.Co.

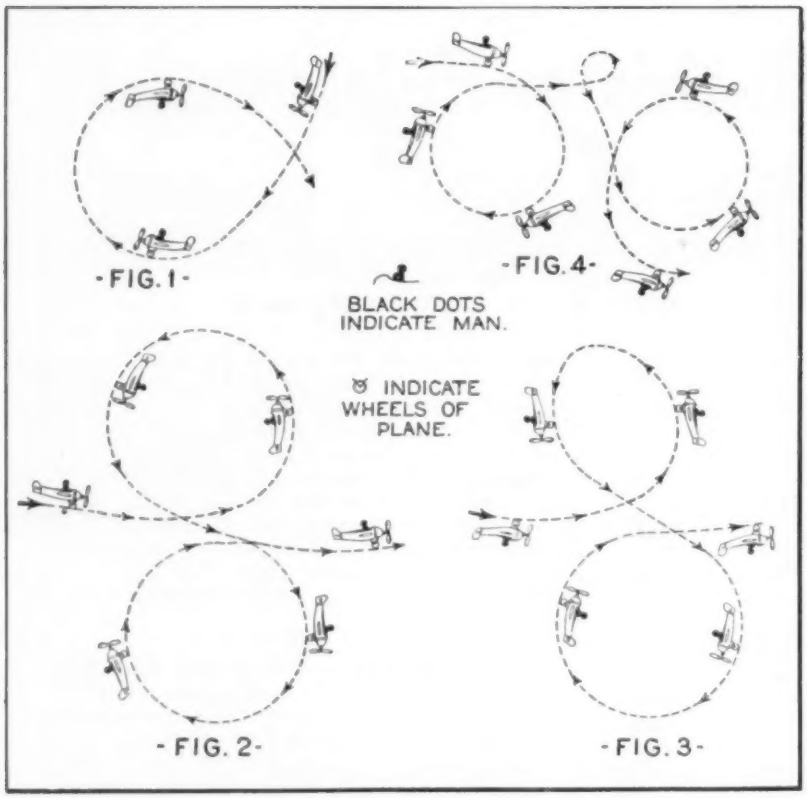


Figure 1: An ordinary loop. *Figure 2:* A vertical figure of eight as performed by Fiesler. It is an ordinary loop followed by an inverted loop. *Figure 3:* Vertical figure of eight beginning with an inverted loop, followed by an ordinary loop. *Figure 4:* Horizontal figure of eight by Al. Williams

the instant of flattening out, the accelerometer records made by Doolittle show a centrifugal force of seven times the pilot's weight. But this force is pressing the pilot firmly to his seat. Also in the ordinary loop while the machine may sometimes be flying upside down in space, the wings are always at a positive angle to the flight path and therefore acting efficiently throughout the maneuver.

In the inverted loop shown in the second of our diagrams, when the pilot is at the bottom of the circle, the centrifugal force is very great, but it is acting now in such a way as to throw the pilot out of his seat. It also causes the blood to flow to his head, giving an impression that his head is swelling. There is a double danger therefore. The tendency to throw the pilot out of his cockpit is resisted only by the safety belt, and the high loads plus the tendency of blood to the head may produce unconsciousness far more readily than in the ordinary loop.

There is little doubt that the Navy has acted wisely in prohibiting the making of outside loops in future. The reason why the inverted loop was so long in coming was not because of the danger involved, however. The difficulty was that in the inverted loop the wings have to resist the centrifugal force by giving a force directly opposite to their normal lift. The wings are therefore really acting in a negative condition, their efficiency is low, and even with high initial diving speed pilots failed to make the vertical climb after the flattening out at the bottom of the circle.

Fiesler improved on Doolittle by inventing a number of modifications and combinations of the inverted loop as illustrated in the diagrams. Figure 2 shows the vertical figure of eight, in which after diving to attain great speed, the pilot flattens out and goes into an ordinary loop, and then passes into an inverted loop. Figure 3 shows a figure of eight, where the pilot dives, goes on his back at great speed, makes an inverted loop, and then makes an ordinary loop coming out horizontally in an inverted position.

In preparing for these maneuvers, Fiesler thinks every step out carefully and drills himself in the fact that, flying upside down, all longitudinal control has to be the reverse of ordinary controls. Thus in ordinary flying to raise the nose of the machine, the stick is pulled back; in upside down flying to raise the nose of the machine, the stick is pushed forward. He even used a model of an airplane to get all the proper maneuvers carefully in mind.

It may be asked what remained to be done by Al. Williams. If we are to believe the *New York Evening World*, he does what is illustrated in Figure 4. First an outside loop; then a half roll and an inverted loop from an inverted position. The figure of eight performed in a horizontal plane, is nevertheless a vertical one seen from the side.

We hope that our readers will enjoy the mental exhilaration of following through these maneuvers, imagining how they would feel in each position, and thinking out exactly what the proper movement of the stick is in each attitude.

Metal Hulls

THE British are a maritime people, and it is not at all strange that they should give much attention to the construction of large flying boats to connect up their sea-girded empire. Short Brothers of Rochester, England, are now completing an 18-passenger flying boat to be used on the Empire Airway between England and Australia. It is equipped with two Bristol Jupiter engines, of a total of 1500 horsepower, and has a wing structure of the conventional biplane type. The interior of the boat hull has luxurious passenger accomodations with a refreshment buffet at one end, and baggage space at the other end.

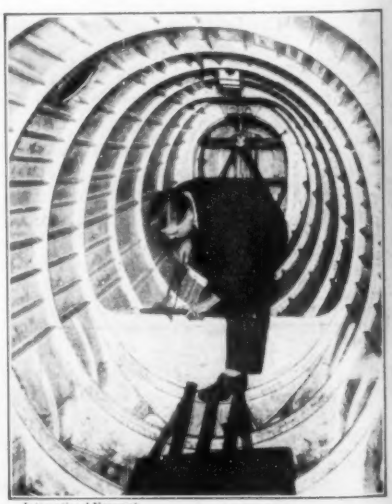
The construction of these metal hulls is to a large extent a problem in naval architecture. Disregarding the question of aerodynamics and planing ability, the problem is one of building a water-tight vessel of great lightness and refinement, yet capable of withstanding severe shocks on landing, and buffeting in fairly rough water.

As regards material, duralumin is at present used almost exclusively. It will undoubtedly give the lightest hull construction for a given weight, surpassing even the strongest steel in this respect.

The corrosion of duralumin in sea water is a difficulty. Many methods of protection have been developed. A serious rival to duralumin alone is "alclad" developed by the Aluminum Company of America, in which the dural sheet is sprayed on both sides with pure aluminum. The material is heat-treated and diffusion of the alloy into the pure metal takes place, thus ensuring perfect cohesion. The pure aluminum coating serves to give excellent protection against corrosion, although the strength of the "alclad" is somewhat less than that of dural alone.

Magnesium alloys, lighter even than the aluminum alloys, and more promising from the point of view of corrosion, are also being investigated.

The structure of the hull is simple in principle, but difficult of execution. Our photograph showing the rear portion of the Short Brothers hull is instructive. The shell or outer cover of the hull must be thin if the weight is not to be excessive. Therefore it is supported at frequent intervals by the circular or almost circular transverse frames. From stem to stern of the hull run longitudinal stringers or girders, continuous so that they may de-

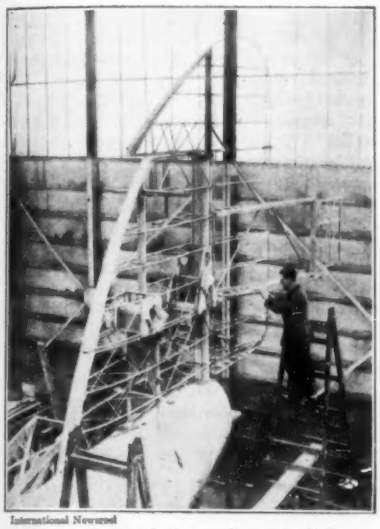


International Newsreel

Interior of the hull of new flying boat being built in England

velop the greatest strength in resisting bending moments.

With the large number of girders and frames employed, each of which are relatively light, the thin shell is made to contribute an appreciable element of strength. Where the step comes in, and where the hull has complicated water lines, the diffi-



International Newsreel

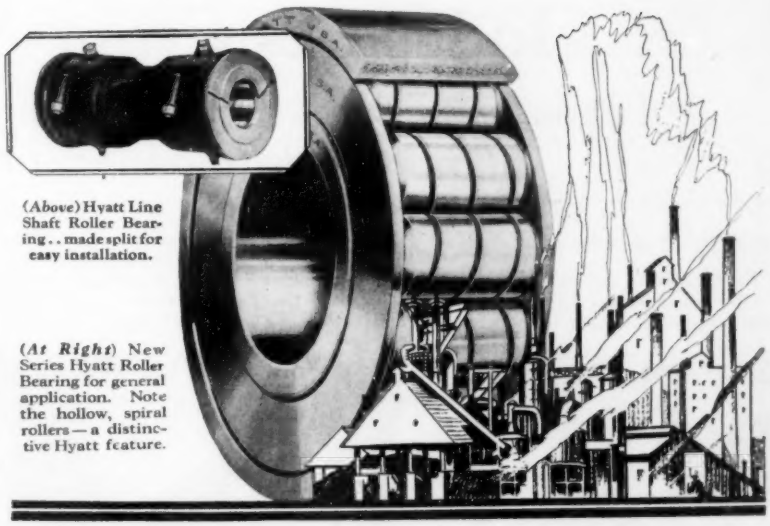
View of the balanced vertical fin and rudder of the large flying boat

culties of construction are even greater. But even for the rear portion of the hull as illustrated, there is a great amount of careful fitting and riveting to do.

The size of the hull is well illustrated by the photograph which shows the vertical fin and rudder in process of construction. The vertical fin is braced rigidly to the hull, and carries at its rear end a vertical post to which the rudder is hinged. The rudder is of the balanced type with the front upper portion projecting beyond the hinge post. We believe that the small auxiliary surface carried on an extension of two frames of the rudder is a Flettner auxiliary rudder. The pilot has only to actuate the rear auxiliary surface, and it in turn serves to move the large rudder. With the Flettner auxiliary rudder, even very large control surfaces may be actuated with perfect ease.

Underwood & Underwood

An alarm altimeter designed for use in the next international balloon races by Ward T. Van Orman. When the balloon approaches the ground too closely for safety, a light flashes and a buzzer sounds, warning the pilot of his danger



(*Above*) Hyatt Line Shaft Roller Bearing . . made split for easy installation.

(*At Right*) New Series Hyatt Roller Bearing for general application. Note the hollow, spiral rollers — a distinctive Hyatt feature.

Enemies *of* Friction . . . friends *of* Power!

BETTER products every year . . . . better markets in which to sell them . . . . but better products and better markets are of no avail unless profits are retained.

Production must be swift . . . consumption of power must be constant . . . . material handling equipment must be free-running. Human and mechanical energy must be conserved.

In the wasteless transmission of power and in the effortless handling of materials by hand or by motor, Hyatt Roller Bearings play an essential part.

Practically every production operation can be rendered more profit-saving by these enemies of friction . . . . these friends of power.

Hyatt engineers will be glad to explain.

HYATT ROLLER BEARING COMPANY

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PRODUCT OF GENERAL MOTORS

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Mill Waste for Mosquito Control

THE disposal of the waste sulfite liquor from paper mills is a problem that has vexed manufacturers and their chemists for some time. At present this spent cooking acid is run into the streams, causing a pollution which is, in some cases, objectionable to other manufacturers located on the same streams and has effects on the animal and vegetable life. Attempts have been made to use this waste product for a road-binding material, and various other uses have been proposed, but the large quantities available and the relatively low value of its contents have prevented the development of any universal or profitable method of disposal.

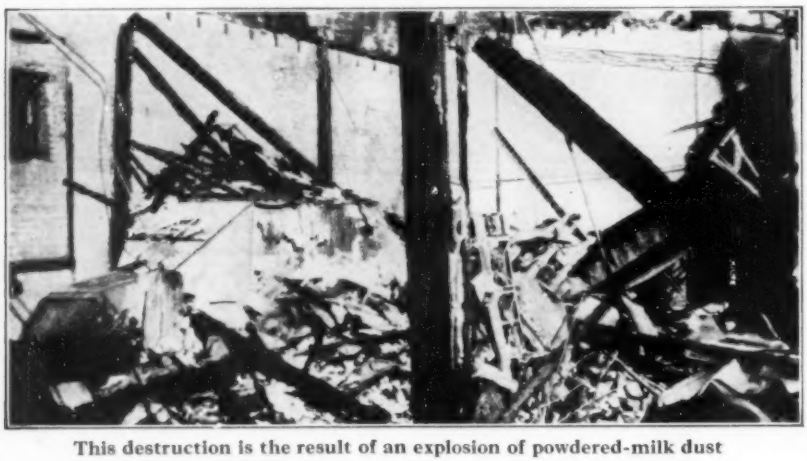
Now comes the news that Canada is using waste sulfite liquor to fight mosquitoes, according to a report submitted to the annual convention of the New Jersey Mosquito Extermination Association by Arthur Gibson, Dominion entomologist, Department of Agriculture, Ottawa.

He said that a test made last summer had shown that most of the mosquito larvae and pupae had been destroyed and the few adults that eventually emerged were killed "by the slowly evolving sulfur dioxide gas before they were able to take to flight."

In so far as he knows, Mr. Gibson continued, "these experiments are original, and may possibly indicate a practical use for this liquor in mosquito-infested areas immediately adjacent to sulfite mills."

Dangers in Dust

THE danger that lurks in dust, or, more accurately, finely divided particles of readily oxidizable substances suspended in air, is not generally appreciated. Flour millers have long been awake to the hazard, for explosions of flour dust have demolished many such mills and cost numerous lives. It was with particular reference to flour mills that the United States Bureau of Standards undertook investigations into the causes and preventive measures for dust explosions. More recently, the Bureau's expert on the subject, D. J. Price, has extended his work to the study of explosions caused by the dust of such materials as starch, dried milk, sulfur, aluminum, sugar, cork, hard rubber, spices, and lacquer.

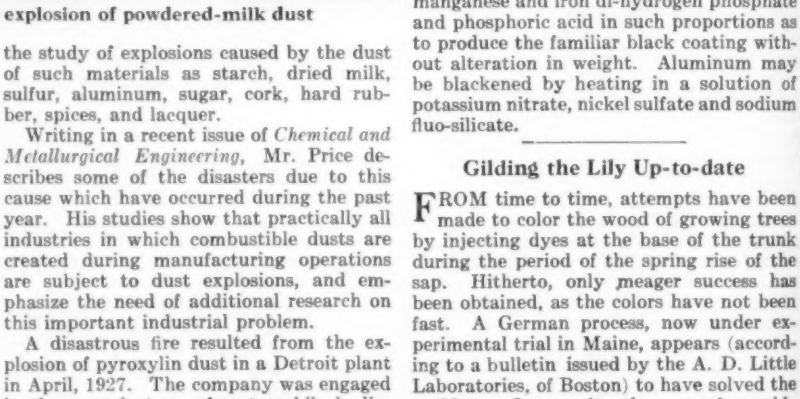


This destruction is the result of an explosion of powdered-milk dust

Writing in a recent issue of *Chemical and Metallurgical Engineering*, Mr. Price describes some of the disasters due to this cause which have occurred during the past year. His studies show that practically all industries in which combustible dusts are created during manufacturing operations are subject to dust explosions, and emphasize the need of additional research on this important industrial problem.

A disastrous fire resulted from the explosion of pyroxylin dust in a Detroit plant in April, 1927. The company was engaged in the manufacture of automobile bodies and painting operations in connection therewith. The explosion resulted in a loss of 28 lives and approximately 4,500,000 dollar property damage. Early reports indicated that the occurrence was due to ignition of vapors and gases from the pyroxylin lacquers used in the paint spraying operations. A thorough study of the explosion, however, has proved definitely that the explosion was caused by the ignition of pyroxylin lacquer dust. The investigators concluded that the explosion originated either inside the auxiliary box around a mercury-vapor electric lamp or from the ignition of the vaporized paint by static electricity.

Sixteen explosions of starch dust were carefully studied. Three of these explosions originated in the grinding and pulverizing equipment, three originated in the drying machinery, three originated during the operation of conveyors and transporting equipment, three were traced to the use of open flame lamps, one was traced to the breaking of an electric lamp bulb, and one was ascribed to static electricity. The causes of two were undetermined. As a result of these explosions 115 lives were lost, and 91 people were injured.



Starch plant completely demolished by a dust explosion

Rust-proofing With Phosphates

AN interesting method of rust-proofing iron and steel is being exploited by the Parker Rust-Proof Company, of Detroit. The articles are heated in a solution of manganese and iron di-hydrogen phosphate and phosphoric acid in such proportions as to produce the familiar black coating without alteration in weight. Aluminum may be blackened by heating in a solution of potassium nitrate, nickel sulfate and sodium fluo-silicate.

Gilding the Lily Up-to-date

FROM time to time, attempts have been made to color the wood of growing trees by injecting dyes at the base of the trunk during the period of the spring rise of the sap. Hitherto, only meager success has been obtained, as the colors have not been fast. A German process, now under experimental trial in Maine, appears (according to a bulletin issued by the A. D. Little Laboratories, of Boston) to have solved the problem. It permits the use of a wide range of dyes; and it is claimed that the resulting colors are not only permanent, but deepen with age. From the wood so colored, many attractive novelties such as

umbrella handles, door knobs, brush backs, buttons, and boxes have been made, with pleasing results.

The dye is distributed throughout the tree from a reservoir formed by boring a number of one-inch holes in the trunk, about four feet from the ground, and other holes through two or three large roots. The dye solution is placed in a 16-gallon container, hung on the tree about 12 feet from the ground, and connected with the reservoir and holes in the roots by rubber piping. A tree of 15 inches diameter will absorb the contents of one of these containers in about 18 hours. From 75 to 100 gallons of the dye solution are required to color the tree completely. The operation is rather expensive, about six pounds of dye being required for the average tree.

The proper shaping of the reservoir involves considerable time and labor. The process seems to suggest new possibilities in the making of marquetry floors, novelties, wood products, and furniture, and if these find favor, the process may afford a profitable outlet for woods for which no favorable market has previously been found.

Heat-Insulating Material

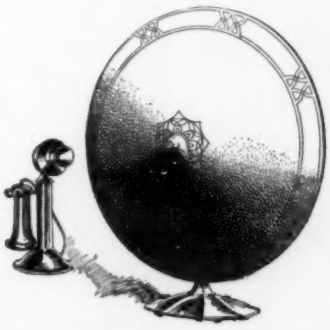
THE total heat lost from a hot pipe, a furnace, et cetera, is made up of three parts: Loss by conduction, by convection, and by radiation. The usual insulating materials are calculated to reduce the first two components of the total loss, but are not effective against radiation losses. In fact, it is well known that the heat-insulating properties of magnesia, asbestos, and similar substances are due to the porosity and that most of the heat transmitted passes by radiation from surface to surface across the pores rather than by simple conduction.

Polished metallic surfaces, however, have very low co-efficients of heat emission while asbestos and similar surfaces have co-efficients 10 to 20 times greater. This is the basic principle applied in a new insulating material developed abroad under the name "Alfol." It consists of bright aluminum foil built up in three, four, or five layers about half an inch apart with suitable separators. The foil is embossed and is used in two thicknesses—the thin for the inside layers and the thick for the outside, for greater rigidity. In cases where this method is not convenient, the crushed foil is placed in the space to fill it loosely.

On test, the only materials giving figures near those of "Alfol" are glass wool with the fibers in the direction of heat flow, and cork in thin sheets. An important consideration is the lightness and low-heat capacity of the material, but a drawback is the fact that tarnishing of the foil would occur in many situations, with a consequent drop in the value of the insulation.

Paraffin Used in Producing Zinc

A PROCESS developed in England by H. Edwin Coley for the reduction of metallic oxides by the use of paraffin oil is attracting much interest, partly because it is radically new and seems to offer a very great range of applications and, also, because the rights for manufacturing zinc by this process have recently been acquired by the N. C. Metal Company, Ltd., at a figure reputed to establish beyond question the value this manufacturer places on the



ANOTHER MEMBER OF THE TELEPHONE FAMILY

MANY a radio set has found a new and richer voice in the golden-throated Western Electric loud speaker.

Produced by the world's foremost experts in sound transmission—Bell Telephone Laboratories and the Western Electric Company—this loud speaker is responsive both to low bass notes and high treble, reproducing them with fulness of tone and absolute fidelity.

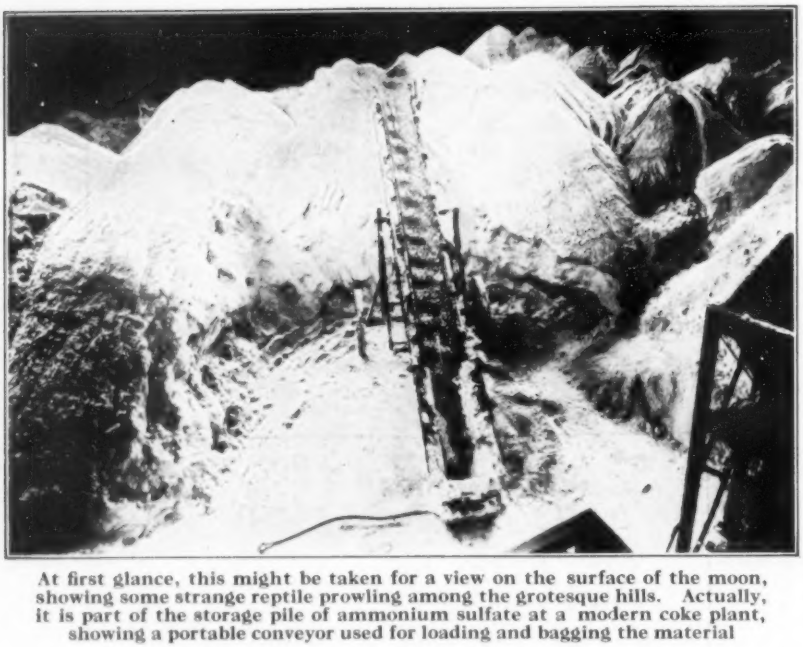
The same engineering skill which developed the telephone has thus removed a serious shortcoming in radio loud speakers.

Here again the name Western Electric is an assurance of mechanical and electrical reliability—whether on loud speaker or on telephone; microphone; public address system; music reproducer; the orthophonic horn and electrical recording for the phonograph; audiometer; audiphone and the talking moving picture. As manufacturers of the nation's telephones, this Company is applying the skill thus gained to making a widening range of communication apparatus.

Western Electric

Purchasers... Manufacturers.. Distributors

SINCE 1882 FOR THE BELL SYSTEM



At first glance, this might be taken for a view on the surface of the moon, showing some strange reptile prowling among the grotesque hills. Actually, it is part of the storage pile of ammonium sulfate at a modern coke plant, showing a portable conveyor used for loading and bagging the material

process. Mr. Coley and his colleagues have, during the last three or four years, been engaged in experimenting on a general process for the reduction of metallic oxides, based on the supposition that paraffin oil, introduced at the moment of cracking, would be extremely active as a reducing agent.

A revolving cylinder containing the oxide is heated to the proper temperature, which in the case of zinc, is between 1000 and 1200 degrees, Centigrade. Inside the cylinder is a water-cooled pipe through which paraffin oil is allowed to flow. The cracking of the oil gives nascent carbon and possibly other nascent elements or compounds which effect the reduction very rapidly.

From the experiments made, it seems that there is one temperature for each metal most suitable for this reduction, and that in dealing with a mixture of oxides of different metals it usually happens that the whole of one metal is reduced before any of the others are affected. The process has been applied to a dozen metals, but only in the cases of iron and zinc have the operations been conducted on a commercial scale.

It is predicted that the process will be applicable to a considerable number of naturally occurring carbonates and oxides, as well as to some of the complex ores which are troublesome and expensive to smelt by existing methods. In some of these cases an inconvenient metal may be entirely removed in a volatile state and yet may be easily recovered. In the case of the reduction of zinc oxide or carbonate, the vapors of zinc, with other vapors and solid particles carried over from the process, are passed into a water spray which brings down the metal in a state which facilitates its collection, drying, and distillation.

"Factory Farming"

FOOD production by bacteria and other micro-organisms fed with suitable mineral products may become practical, according to Firman E. Bear of Ohio State University (Columbus), through the cheapening of synthetic ammonia. This type of "factory farming" without the necessity of using vast areas for exposing plants to sunlight may be much nearer than most people suppose, according to Dr. Bear, who continues:

"It may not be well to speculate too far or to raise any false alarms, but one would not go amiss perhaps to call attention to some interesting possibilities that are being investigated in the production of synthetic foods capable of replacing high-protein feeds for animals and meat and milk for humans, without loss of palatability. There is no longer any question but that such foods can be produced and at a cost that is not prohibitive. In fact, they are now being manufactured and sold in considerable amounts."

Fingerprinting Smells

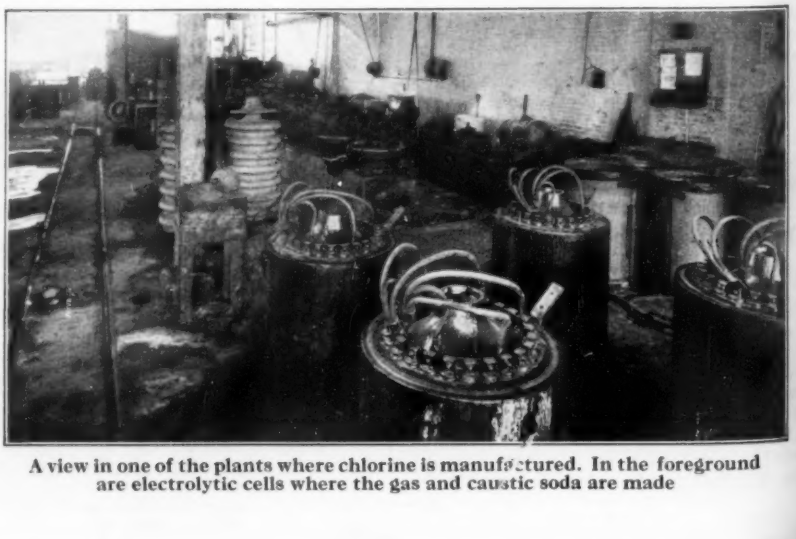
ODORS can now be reduced to figures by a system that recognizes four constituents: Fragrant—as the sweetness of flowers; Acid—as the sourness of vinegar; Burnt—as tarry odors; Caprylic, or goaty—a putrid factor. Under this system, vanillin, the principal ingredient of vanilla extract, has a fragrant rating of 6, an acid rating of 0, a burnt rating of 2, and a caprylic rating of 1. Hence, 6021—vanillin. No odor has yet been found which cannot be classified in this way.

Poison Gas for Peace-time Industry

CHLORINE, the heavy green gas whose appearance on the western front during the World War marked the opening of chemical warfare and which later was made the basis of the even more deadly poison gases, has lately become an industrial chemical of first importance. Ten years ago, when the United States Government approved the plans to build a 100-ton per day chlorine plant at Edgewood Arsenal, no one suspected that this immense output would so soon be exceeded in size by a single industrial plant in peace-time production. Yet such has been the growth of the synthetic organic chemical industry since the war, that the production of chlorine has had to develop to undreamed proportions to keep pace with the demand.

Chlorine is manufactured by the electrolysis of salt—sodium chloride. As the gas is liberated at one electrode, sodium is formed at the other, where it immediately reacts with the water of the electrolyte to form sodium hydroxide or caustic soda solution. The most modern plant for the production of these twin products is that of the Westvaco Chlorine Products Company, Inc., at Charleston, West Virginia, which is described in a recent issue of *Chemical and Metallurgical Engineering* by Sidney D. Kirkpatrick. This model plant produces 100 tons of the gas a day, and embodies the latest improvements in technology.

As in most successful chemical-engineering developments, this large-scale and efficient production of chlorine and caustic soda was preceded by exhaustive preliminary investigation. L. D. Vorce, chemical engineer of Montclair, New Jersey, joined the Westvaco company as a consultant in January, 1927, and at that time put in four test cells of the most modern cylindrical type. These were connected in series with the existing installation and daily records were kept of their operation over a period of three months. During this time they showed an average current efficiency of 97.01 percent. Operating at an average voltage of 3.49 with average amperage of 943, their power efficiency was 64.6 per-



A view in one of the plants where chlorine is manufactured. In the foreground are electrolytic cells where the gas and caustic soda are made

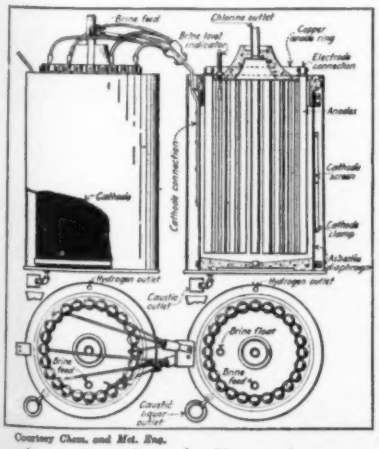
cent. The average NaOH content of the effluent was 103 grams per liter.

On the basis of this demonstration and the comparative results of other studies, the contract was let for 2240 cells to be arranged in 32 series of 70 cells each. Since commercial operation began on September 1, 1927, 24-hour test runs have been made each month on all of the cells and the average results are given in the following table:

Specific gravity of liquor	1.211
Percentage of NaOH	8.607
Percentage of NaCl	15.79
Percentage of Na_2CO_3	.115
Percentage of NaCl	Trace
Percentage of $NaClO_3$	.068
Percentage of Cl in gas	98.3
Percentage of CO_2	.7
Gallons of liquor per cell per hour	3.417
Pounds of caustic per cell per day	71.42
Pounds of chlorine per cell per day	63.15
Pounds of caustic per kw.-hr.	.859
Pounds of chlorine per kw.-hr.	.793
Pounds of caustic per kw. day	21.42
Pounds of chlorine per kw. day	19.08
Average amperes per cell	948.1
Average volts per cell	3.5
Temperature of brine, deg. F.	147
Current efficiency (percent)	94.84
Power efficiency (percent)	62.11

The hydrogen gas, collected from the outlets of the cells, is piped to an adjoining plant where it is consumed in chemical manufacture.

Six double-effect evaporators are used to concentrate the dilute caustic liquor in the evaporator house. A seventh of the same type is used to produce salt from the brine obtained from 940-foot wells on the company's own property. Under normal operating conditions, a considerable portion of the caustic soda is sold as strong liquor which is pumped to the plant of a nearby consumer. This is concentrated to 48 degrees Baumé (about 46 percent NaOH) and



Courtesy Chem. and Met. Eng.

A cross-section of a Vorce electrolytic cell for chlorine production

then cut back to a specific gravity of 1.295 (33 degrees Baumé) in order to prevent trouble from freezing. Solid caustic soda containing less than 1.2 percent of NaCl is also produced on a considerable scale at this plant.

In addition to the brine from its own wells, the Westvaco company purchases some rock salt. This is elevated from freight cars in which it is received, to three salt tubs each of 60,000 gallons capacity. In these the raw brine solution is made up to proper strength. This is pumped to

(*Please turn to page* 557)

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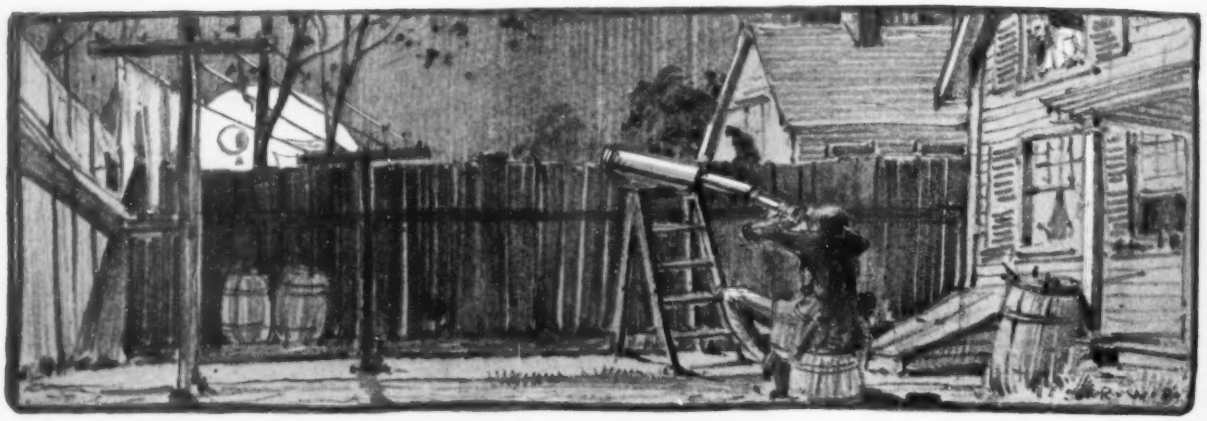


The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

THIS month we shall devote most of our space to an interesting letter from Mr. Vard B. Wallace, a chemist, Box 874, Long Beach, California, and wind up with a brief description of two newly discovered

Mr. Wallace and his telescope

methods of grinding and polishing mirrors. Mr. Wallace's communication follows:

"Editor Amateur Telescope Dept.:

"At the time the articles on telescope making first appeared in the SCIENTIFIC AMERICAN, I was teaching machine shop and physics in the Industrial College of Guatemala City, Central America. I sent to you for the book, 'Amateur Telescope Making,' and obtained two six-inch glass disks, some abrasives and rouge. I went through the book carefully several times before commencing work, translating most of it into Spanish for the benefit of the boys in my physics class. The work of grinding and polishing was done in an adobe house with walls 18 inches thick. This proved ideal for the job as the temperature change did not usually exceed five degrees in the 24 hours.

"It was impossible to obtain pitch in Guatemala, so resin was used. Instead of adding turpentine to bring the lap to the right consistency, we found it necessary to boil the strained resin a few minutes to make it harden properly. About a dozen laps were made before a good one was obtained. The polishing went much better than we anticipated and there was no trouble from scratches. The shadow testing was difficult, but a week's squinting along the razor edge gave us enough experience to interpret correctly the shades in terms of curves. The mirror was finally brought to a uniform sphere and then parabolized to a little more than half the conventional correction.

"Then came the silvering. It cost us nearly five dollars in chemicals to learn that the book meant EXACTLY what it

Mr. Wallace's telescope set up

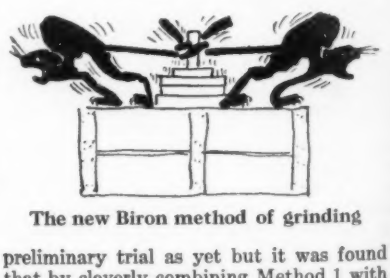
said about avoiding an excess of ammonia. After that the six-inch mirror, as well as several small flats, were silvered.

"Altogether, the instrument was very satisfactory for a first attempt and greatly stimulated the boys' interest in the heavens. Since that time I have made another six-inch mirror and two ten-inch mirrors.

"The first ten-inch mirror was made for and with the help of Dr. J. A. MacKnight, Director of the American Academy of Guatemala City. This is the instrument shown in the picture. The tube is built up of half-inch mahogany strips bound at the ends with cast aluminum hoops. The cell is of the same material and is double, with four leveling screws. The mounting was cast and machined in the school shop and is arranged to be placed on a concrete column. In the picture it is shown on a temporary support for the first trial as it came out of the shop."

THE newly discovered methods of grinding and polishing we adverted to at the start are: (1) The so-called "Biron" method invented by Mr. C. H. Biron, a member of the amateur fraternity who lives in Pittsfield, Massachusetts. Mr. Biron's clear elevation drawing is virtually self-explanatory. The curve produced is not a paraboloid but a catenary. (2) A method brilliantly conceived by the Tel. Ed. while eating a typical New York commuter's swallow-and-run breakfast. In this method a hot waffle is employed for the lap and the polishing agent, which is retained in the ready-made indentations in the lap, is Vermont maple syrup (we used this out of loyalty to Vermont where amateur telescope making took its recent rebirth, and we are loyal to our origins if nothing else).

The second method has been given only



The new Biron method of grinding

preliminary trial as yet but it was found that by cleverly combining Method 1 with Method 2, and replacing the left-hand cat with a Pomeranian poodle of substantially equal mass, it was possible to turn out a completely parabolized mirror in less, even, than the two or three hours required where Mr. A. W. Everest's new honeycomb

(*Please turn to page* 562)

Industries From Atoms

(Continued from page 555)

storage tanks and treated with sufficient soda ash to remove calcium and magnesium. After agitating with air to assure complete reaction, the brine is allowed to settle and is then pumped to the finished brine tanks where sufficient HCl is added to cut down the excess of NaOH. As sent to the cells, it is desirable that the brine be neutral or only slightly alkaline.

Methanol from Wood Distillation

MUCH has been said recently on the subject of the synthesis of methanol from coal gas and the economies this process will effect. In the meantime, Messrs. Frolich, Spalding, and Bacon of the Massachusetts Institute of Technology have studied methods of increasing the yields of methanol and other materials obtained in the destructive distillation of wood and find that modifications of the process as practiced increase its value. Their conclusions as reported to the American Chemical Society are in part as follows:

"Wood and cellulose, either alone or impregnated with catalysts, have been distilled under pressure in an atmosphere of hydrogen, nitrogen, or of the gases evolved in the distillation.

"Pressure alone favors the formation of methanol, as evidenced by a doubling of the methanol yield under a hydrogen pressure of 200 atmospheres. The autogenous pressure of the gases evolved in the distillation has a similar effect. With the catalysts studied, the yield of methanol is usually decreased at atmospheric pressure and barely improved when higher pressure is employed.

"With nickel as a catalyst and hydrogen under 200 atmospheres, cellulose is almost completely converted into gaseous and liquid products, the latter consisting of phenols and saturated and unsaturated hydrocarbons. When nitrogen is substituted for hydrogen, the cellulose is volatilized to practically the same extent.

"Whether this process of decomposition of cellulose and wood to form phenols and hydrocarbons will meet with commercial success would seem to depend to a large extent on the development of suitable equipment for continuous operation."

Ubiquitous Sand

ONE of the most ubiquitous of chemicals, sodium silicate, now promises to demonstrate its versatility by playing a part in aircraft development. It has been found that aluminum and its alloys, which are obviously of extreme importance in aeronautical construction, can be protected against corrosion by a coating of sodium silicate, which at the same time reduces the permeability of the metals. A patent covering the process has been granted to Zimmerman and Daniels.

The resistance of aluminum to corrosion, especially under alkaline conditions, leaves much to be desired. It dissolves rapidly in a hot 5 percent solution of sodium carbonate, but an addition of 1 percent of a silicate of soda which contains a relatively large ratio of silica stops the action completely. The reason is found in a thin, translucent film which is deposited on the surface and keeps the metal and the corrosive soda-ash solution apart. This film is composed principally of silica and water, and it has

Names—and what they mean

Bessemer Steel

Three score and ten years ago Henry Bessemer, English engineer with inventive turn of mind, brought into practical use a method for converting melted cast iron into a steel in a perfectly fluid state. His discovery was of greatest industrial importance because it reduced cost of manufacture nearly $100 a ton and made steel available for innumerable uses. While others scoffed, Bessemer erected his own plant and produced better steel which could be sold at lower prices. Within a few years there came to the inventor more than $4000,000 in royalties. The name of Bessemer, because of the quality of steel and low price his discovery made possible, will ever be associated with whatever progress has been made in the manufacture of steel since his time, even though his process is now largely supplemented, and in some instances displaced by other methods. Bessemer's work paved the way for modern skyscrapers, great bridges, the endless uses to which steel is now put. It is worthy of note that some names begin by being merely tags to identify a product and are soon forgotten. Other names, like Bessemer, acquire, through years of superlative merit in the product itself, a personality, a definite measure of value that is quickly recognized. Such a name, for instance, is

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It is accepted as a standard of excellence and value in the invention, manufacture and employment of instruments for indicating, recording and controlling temperature in the home, the office, the factory, the hospital, and on the farm. In industry alone the name TYCOS symbolizes a Sixth Sense which makes possible the correct and efficient application of the five familiar senses—sight, hearing, smell, taste and touch. TYCOS on Temperature Instruments means the same as Bessemer as applied to steel.

It has well been said by noted authorities that iron, most abundant and cheapest of heavy metals, strongest and most magnetic of known substances, is perhaps also the most indispensable of all save the air we breathe and the water we drink.

For one kind of meat we can substitute another; wool can be replaced by cotton, silk or fur; glass has its substitute, but even if the earth could be made to yield any substitute for the millions of tons of iron and steel which we use each year for rails, wire, machinery and structural purposes, we could not replace the steel of our cutting tools or the iron of our magnets, the basis of all commercial electricity. From the mining of the ore itself through all the processes to needles and pins, razors and rapiers, transformation of the metal into useful implements depends on the application of heat. How much, how little, how long heat must be applied is indicated, recorded and controlled by TYCOS Temperature Instruments. The employment of TYCOS Temperature Instruments makes possible the countless possibilities wherein iron and steel are made to serve men

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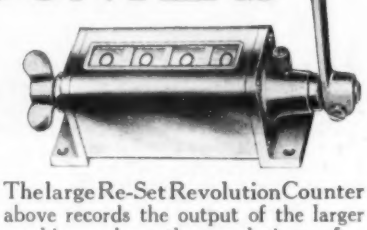

Below is small Set-Back Ratchet Counter, which indicates one for each throw of the lever, moving through an angle of 45 degrees. Reset to zero from any figure by turning knob. A very free and easy - moving counter, requiring little power to actuate it. Has stops to limit the throw of the lever, with return - action spring to bring lever to its initial position. Applicable to a wide range of light machinery. Price, $6.00. Equipped with lock and key to prevent tampering with the record, $2.00 extra. Also furnished in a Revolution Counter.

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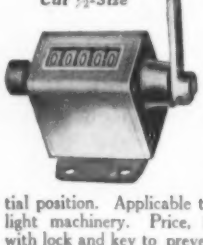

The large Re-Set Revolution Counter above records the output of the larger machines where the revolutions of a shaft record operations or output. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price, with four figures, as illustrated, $10.00 (subject to discount). Similar model in a Rotary Ratchet Counter (with re-set), price $11.50—list.

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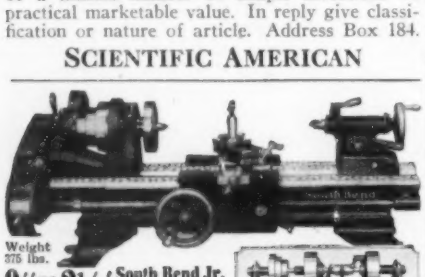

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the character of a jelly. The smaller the amount of water present when it is formed, the denser it will be.

Silicate of soda looks like white molasses. Many are familiar with it under the name "water glass," used for "putting down" eggs. It is made from sodium carbonate and sand. Until recently, its presence in soap was considered an adulterant, a substitute for fat. But that has all been changed. For chemists have discovered that the collodial character of sodium silicate makes it an excellent detergent in soap —that is, a cleanser which floats out dirt.

Other uses of sodium silicate include the lining of barrels for vegetable and animal oils and fats of edible quality. The silicate film is cheap, sterile, impenetrable to oil, and imparts no taste to the contents. Cartons for coffee, spices, crackers, et cetera, are made of paper board with a silicate film to protect the contents. Silicate solutions introduced into corrosive public water supplies have been found to reduce the corrosion of lead and iron pipe lines.

It is a regular practice in some chemical factories to spray the under sides of wooden roofs or other wooden structural members periodically with silicate as a protection against fire. Wood lined railway tunnels painted with silicate are most unlikely to take fire from sparks. The protection is sometimes increased by throwing sand upon the wet silicate film, where it sticks and adds to the protection. Of course a film laid over a material such as wood cannot give absolute protection. If heat is continued long enough, the wood will burn, but a spark which falls on a silicate film goes out before it can ignite the wood, or a flash of flame sufficient to catch the bare wood takes no hold on the silicated surface.

Periodically we meet the inventor who thinks he has discovered in silicate a substitute for varnish. He is doomed to disappointment. A silicate of soda film looks like a transparent varnish, but in course of time it tends to lose its luster by the action of moisture and carbon dioxide. It never is completely insoluble until it has been altered by chemical reaction, and thick films when long dried, are too glass-like for uses which need flexibility.

Chemistry of Cleaner Clothes

SOME unknown cynic, with tongue in cheek, commented on the injustice of life in the words: "The coat and pants do all the work but the vest gets all the gravy." The dry cleaner will testify to the contrary, however; for he finds grease spots, stains, and plain ordinary dirt pretty generally distributed over the garments that pass through his shop. The dry-cleaning industry has grown to tremendous proportions. It is fundamentally a chemical engineering process and as such has engaged the attention of some of our best chemists, with the result that better work is being done at less cost by the large, up-to-date dry-cleaning establishments.

Our British cousins are much interested in the subject, as shown by a recent joint meeting of the Society of Chemical Industry with the Society of Dyers and Colourists in London, where A. I. Hatfield and E. A. Alliot described a newly developed dry-cleaning process. The authors stated that in attacking the question of dry cleaning they set before themselves not merely a high output and great economy in labor and materials, but also a very high

standard in the finished product, and, as a result of several years of joint work, this has been obtained, and is now in successful operation on a very large commercial scale, the daily output of some of the plants averaging two to three thousand suits per day—literally tons of clothing daily.

In the new process, the goods to be cleaned are continually flushed with very large quantities of pure, clean solvent which is practically freed from all bacteria, et cetera, and contains special soaps which are extremely effective in removing stains of all kinds. The soap solution contains a special detergent which is not only adapted to filter freely, but is also very helpful in the cleaning process itself. In fact, it is such that it might be regarded as soap during the cleaning part of the process, and a reagent so far as the treatment of the solvent itself is concerned.

The bath in the washing machine is changed every two or three minutes; labor is cut down very extensively; thus the output per man when their system was adopted was increased about fourfold; the output per horsepower was about doubled; the productivity of the floor space was multiplied by a factor of approximately, four; the soap was cut down to 1/20; the solvent was cut down very substantially and the treatment of the solvent apart from the process itself was confined to an occasional distillation.

This continuous process can be applied to any make of washer, including ordinary open washers. The fullest benefit, however, appears when it is applied to the vacuum washing system, which is the ideal towards which the best dry-cleaning practice must necessarily tend. The process incorporates the use of a very high capacity pump, filters and filter aids, so that the dirty solvent is filtered very rapidly and economically for re-use.

The Importance of Small Particles

RUBBER tires and macadamized roads are strong and useful because of the tremendous forces exerted at the surfaces between minute particles contained in them, according to Dr. S. E. Sheppard, of the Eastman Kodak Company, speaking before the Institute of Chemistry of the American Chemical Society at State College, Pennsylvania, recently.

"Tremendous strength can be imparted to so weak and plastic a material as rubber by introducing within it the huge forces developed between the surfaces of minute particles of fillers and the rubber itself," Dr. Sheppard said.

"These forces, of a magnitude in rubber tires of many tons per square inch of rubber, are dependent upon the area of the surface of the particles and hence on their size. It is for this reason that the accurate measurement of sizes of particles is of prime industrial importance.

"In building roads, the production in the surfacing materials of a grading of particle size from large stones down to infinitesimal particles a fifty thousandth of an inch across, gives the road permanence. Similarly the strength of rubber tires depends on the production within the body of the rubber mixture of immense areas for the play of these interfacial forces between the rubber and the filler.

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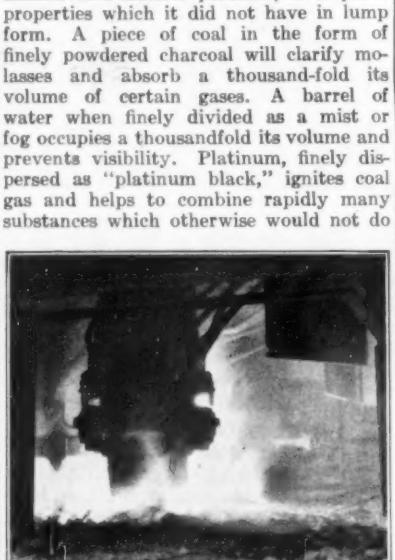
particle sizes of their raw materials for the strength of their finished products. The makers of colors, paints, and inks have always known the importance of the degree of subdivision of their pigments, but it is only in recent years that exact measurements have supplemented the older empirical rules."

Surface forces exerted in the adsorbtion of natural gas by pulverized charcoal are as great as those required to produce pressures of 15,000 pounds per square inch, according to Dr. Victor Cofman of E. I. duPont de Nemours and Company. "No one knows why extreme subdivision of substances should generate such huge forces, but industry profitably utilizes them daily.

"If one divides any kind of matter into smaller and smaller particles, it acquires properties which it did not have in lump form. A piece of coal in the form of finely powdered charcoal will clarify molasses and absorb a thousand-fold its volume of certain gases. A barrel of water when finely divided as a mist or fog occupies a thousandfold its volume and prevents visibility. Platinum, finely dispersed as "platinum black," ignites coal gas and helps to combine rapidly many substances which otherwise would not do



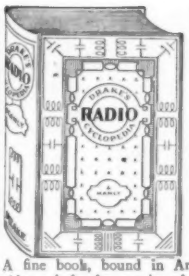
A huge electrode in one of the electric furnaces of the United Lead Company. These massive bars of carbon often are made as large as 45 inches in diameter

so. It acts as a catalyst. The most inactive metals, like silver or lead, when prepared in a finely divided state, in the so-called colloidal form, have valuable medicinal properties, witness for instance the use of silver (protargol, argyrol) in eye diseases and that of lead in cancer.

"No one knows at present exactly why this excessive sub-division should bring about such remarkable changes in the behavior of substances. This behavior is in some way bound up with the presence of a large surface, because the finer the subdivision the greater the proportion of surface to mass. New forces come into play at a surface, or at an interface between two substances, which forces are not found as a rule in the interior of bodies. The surface forces appear directly responsible for the remarkable properties shown by substances in a finely divided state."

The Light That Doesn't Fail—Always

THE Scotchman who was so elated over a drop of two cents a gallon in the price of gasoline because he had received an automatic lighter for Christmas has been



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almost as thoroughly advertised as the lighters themselves. When Scotch stories spring up around cigar lighters it is a sure sign that they have become, for the time being at least, an American institution. Yet, if you stop in the corner cigar store and ask for a piece of pyrophoric alloy, you will probably get a blank stare, and eventually, a scornful, "Oh, you mean a *flint!*"

Pyrophoric alloy, however, is the scientific name for the little black piece of material that throws off sparks when you turn the wheel and it was discovered by Dr. Auer von Welsbach, inventor of the incandescent gas mantle. The incandescent mantle contains 99 percent of thoria and 1 percent of ceria; but the monazite sand from which thoria is obtained contains from 5 to 10 percent thoria and 50 to 60 percent of ceria and other rare earths. On this account, large quantities of rare earths minus the thoria began to accumulate at the mantle works, but von Welsbach was not long in finding a use for a part at least of this, hitherto, waste product. He found that when an alloy of iron and the cerium metals was rubbed with a file, numerous bright sparks were emitted. This property is very rare, and known in but few other instances in the field of nonferrous metallurgy.

Geophysical Prospecting

(*Continued from page* 511)

suitable club for the particular "lie," so in geophysical prospecting the method must be chosen to suit the particular region and circumstances. For example, magnetic methods have long been used in exploring for certain iron ores, hence such methods are universally accepted as sound and normal practice. New methods, however, are naturally regarded with reserve and suspicion until they have been thoroughly and carefully tested. Moreover, as knowledge and experience increase, the problems for solution become more complex and difficult.

Bibliography

A full bibliography will be found in Ambronn's book on geophysics given in the list below. Another bibliography has been published by J. Harlan Johnson, associate professor of geology, Colorado School of Mines. Dr. C. A. Heiland, of the same school of mines, is the author of an admirable summary, "Instruments and Methods for the Discovery of Useful Mineral Deposits," printed in the *Engineering and Mining Journal-Press*, volume 121, January 9, 1926.

A list of useful books follows.

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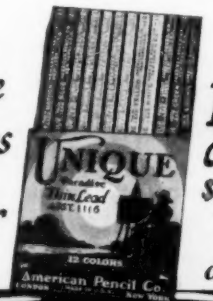

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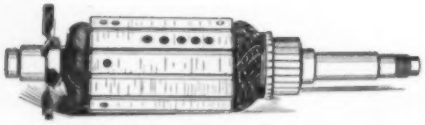

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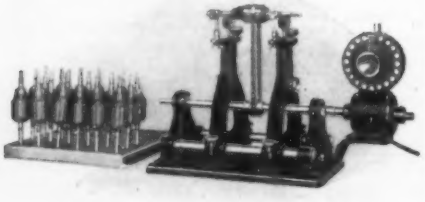


The Back Yard Astronomer

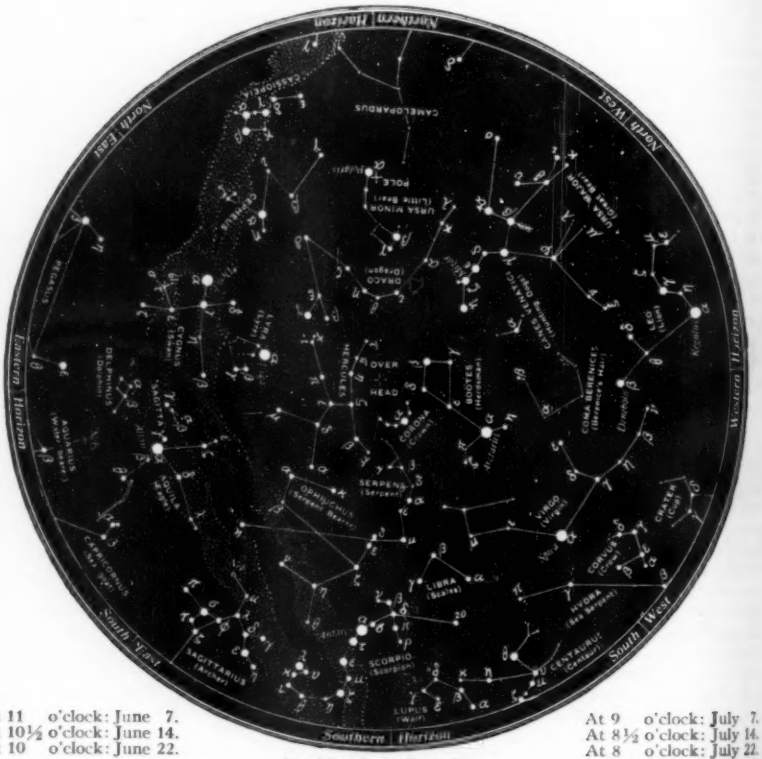
(*Continued from page* 556)

foundation lap, recently described, is used.

As we go to press research is being directed toward making the new method virtually automatic so that the amateur may leave it running and retire, awaking in the morning to find the completed mirror ready to run off under its own power. Thus far, some difficulty has been experienced in bringing the alternations of the cat and dog into proper phase, and practical suggestions are solicited.—*The Tel. Ed.*

The Heavens in June

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.
At 9½ o'clock: June 30.
At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY

The Heavens

MERCURY is an evening star when the month begins, and will be visible just after sunset. He is 23 degrees from the Sun on the 3rd and remains above the horizon till a little after 9 P.M. By the middle of the month he draws in toward the Sun, and on the 29th he passes through conjunction and becomes a morning star.

The Planets

Venus is a morning star, technically, but she rises only a few minutes before the Sun and is practically invisible.

Mars is in Pisces and later in Aries and rises about 1:30 A.M. in the middle of the month. He is still a long way off—about 150,000,000 miles—and is not very conspicuous.

Jupiter is not far from Mars in the sky, but is a little to the eastward and rises later.

Saturn is in conjunction with the Sun on the 6th, and is invisible this month.

Uranus is in quadrature west of the Sun on the 29th and is observable in the morning hours; while Neptune can be seen (telescopically) early in the evening.

The Moon is full on June 3rd at 7 A.M.; in her last quarter at 1 A.M. on the 11th; new at 4 P.M. on the 17th; and in her first quarter at 6 P.M. on the 24th. She is nearest us on the 16th and farthest off on the 1st; and again on the 29th. During the month she passes near Saturn on the 3rd; Uranus on the 12th; Mars on the 13th; Jupiter on the 14th; Venus on the 17th; Mercury on the 18th; Neptune on the 21st; and Saturn again on the 30th.

There are two eclipses this month—the total lunar eclipse on the 3rd and a partial one of the Sun on the 17th. Neither is visible in the eastern United States. The beginning of the lunar eclipse may be seen from the Pacific Coast, the Moon entering the shadow at 5:17 A.M. by Eastern Standard Time, or at 2:17 A.M. by Pacific Standard Time. The middle of the eclipse comes nearly two hours later, by which time the Moon will have set and the Sun risen. The solar eclipse is visible only in a very small region in the Arctic Ocean and on the north coast of Siberia, and is likely to go unobserved.

At 11 A.M. on the 21st the Sun reaches its northernmost point in the heaven and summer begins.

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(*Continued from page 543*)

West St., New York City, N. Y.

Physical Exploration Corporation, 1865 Monroe St., Madison, Wis.; also 111 Broadway, New York.

Geophysical Exploration Corporation, 30 Church St., New York.

North American Exploration Company, 71 Broadway, New York (which is affiliated with the following company).

Geophysical Company of Canada, Limited, 703 Reford Building, Toronto, Canada.

Geophysical Company, Ltd., London, England.

Geophysical Research Corporation, 65 Broadway, New York.

"The foregoing list is believed to be complete, so far as companies having headquarters in the United States are concerned. Readers will confer a favor by bringing to our attention the names of any that have been omitted.

"Among the companies manufacturing or dealing in apparatus used in geophysical prospecting may be noted:

Askanie Werke A. G., 1024 Keystone Building, Houston, Texas (manufacturers of torsion balances, magnetometers and the earth inductor). This firm is the American branch of a Berlin firm of the same name.

Dr. George Steiner (representing Eötvös Geophysical Institute, Budapest, Hungary), 1802 California St., Houston, Tex.

L. Oertling, Limited, 88 Turnmill St., London, EC1, England (Eötvös torsion balance).

Fr. J. Berg, Stockholm, Sweden.

Exploration Boden untersuchungs und Ververtungs G.m.b.h., Linkstr. 25, Berlin, W.G., Germany.

Gesellschaft für praktischen Geophysik (address unknown), Germany.

Ferdinan Züss Institute of Budapest, Hungary (Eötvös torsion balance).

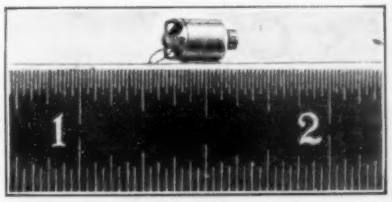
Société d'Entreprises Electro-Techniques, 35 Rue du General Foy, Paris, France.

Keuffel & Esser Co., 127 Fulton St., New York (dip needles).

"Some of the geophysical exploration companies manufacture in their own laboratories the apparatus used by them in their work."

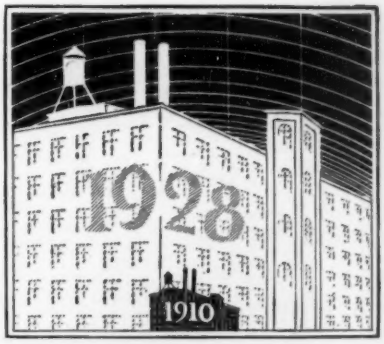
Another "Smallest" Electric Motor

IN the March issue of SCIENTIFIC AMERICAN we published a short description of what was claimed to be the smallest electric motor in the world. Mr. Ivan T. Nedland, a jeweler of Hillsboro, North Dakota, recently wrote to say that a motor he built 12 years ago *is* the smallest in existence.



Mr. Nedland's *tiniest* motor compared to a ruler marked in inches

Mr. Nedland's motor is 19 sixty-fourths of an inch long over all, is 11 sixty-fourths of an inch high, and weighs five and one half grains. It has two field coils and four armature poles wound with number 40 silk-covered wire. The armature is three



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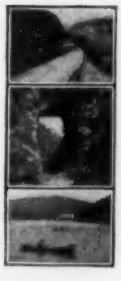

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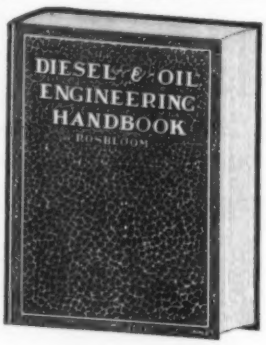

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thirty-seconds of an inch in diameter and the commutator, made up of four solid gold segments insulated from each other with mica, has a diameter exactly half of this. A small flash-light electric cell is used to supply current for running this tiny motor.

The maker says that it took him about seven months of spare time to build the motor, and that no glue or cement was used.

Largest Roller Bearings in the World

TWO huge SKF spherical bearings, of the type shown in the accompanying photograph, the largest of their kind in actual service the world over, have been successfully operating for a period of over three years in a "cylpeb" cement mill at the plant of

One of the two roller bearings that are claimed to be the largest in operation in the world

the Dexter Portland Cement Company, Nazareth, Pennsylvania. These bearings, almost three feet in diameter, are carrying the load of a five and one half foot by 26 foot tube-mill used in pulverizing. The mill is driven by a 250 horsepower motor at a speed of 26 revolutions per minute. The load is 50 tons, or 25 tons per bearing.

During the three-year period, these bearings have been on the job continuously and the only attention required has been replenishing of lubricant several times a year.

Weather Made To Order

ARTIFICIAL winter weather, ranging from a mild day to 30 degrees below zero, has been reproduced in a laboratory at Massachusetts Institute of Technology for studying the effect of low temperatures on certain insects which cause great losses in forest and orchard.

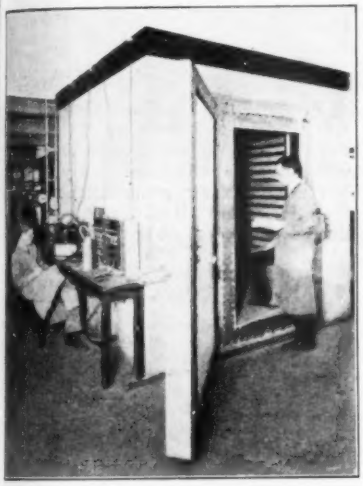
This man-made weather, which in a period of five days ran the gamut of an old-fashioned New England winter, was produced in a specially constructed room in the department of physics under the direction of Professor Gordon B. Wilkes. The undertaking was carried out in co-operation with the Bureau of Entomology of the United States Department of Agriculture, which has a laboratory at Melrose.

As a result of this experiment, which is part of a scientific campaign to prevent further spread of insect pests, the entomologists of the bureau hope it will be possible to forecast relative abundance of some of these insects following severe winters. The tests are also expected to determine definitely

the temperatures fatal to the hibernating forms of the insects treated.

Some 120,000 eggs of the gipsy moth, which attacks forest and shade trees, 35,000 larvae of the brown-tail moth, which damages fruit and shade trees, 400 webs of the satin moth, an insect which defoliates and sometimes kills poplars and willows, and 400 cocoons of the oriental moth, an enemy of fruit trees, were used in the tests. All of these insects have been accidentally introduced into the United States from foreign countries.

In order to compare results of the experiments, several species of native insects were given the same treatment. These included 40,000 eggs of the eastern or apple tree tent caterpillar, about 12,000 eggs of the forest tent caterpillar, some 25,000 eggs of the tussock moth, and 80 cocoons of



The weather room of the Massachusetts Institute of Technology

the promethea moth. In addition to these insect pests, 40 lots of apanteles, a beneficial insect and an enemy of many of the injurious species, were studied to determine the limits of its working range in the New England climate.

On the first day of the experiment the chamber containing the insect specimens, all of which were in the hibernating form, the stage in which the insect usually passes the winter, was cooled to a temperature slightly lower than that prevailing outdoors on that day. Each succeeding day the temperature was brought still lower until, on the fifth day, thermometers in the room registered 30 degrees below zero.

The process, however, was not a continuous and steady lowering of temperature. As such conditions never occur in nature, the greatest care was exercised to simulate natural conditions as closely as possible. This was accomplished by slowly lowering temperature to reproduce the conditions of night and allowing it to rise as it does in nature during the day.

Perfect Metallized Insects

INSECTS made of metal, true to the originals in the last minute details of structure, are produced by a process discovered by Dr. N. D. Zelinsky, a German chemist. As a matter of fact, the insects themselves are metallized through a replacement of their original substance with the metal, just as the details of wood or

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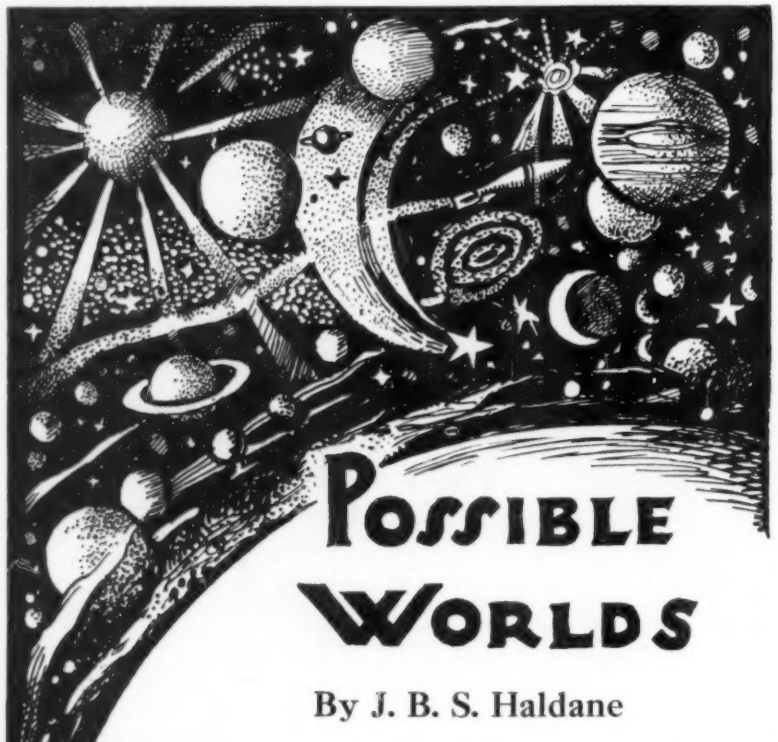

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leaf structure are replaced with stone in petrifactions.

The process was discovered somewhat by accident. Dr. Zelinsky had undertaken to make chemical analysis of some insects. The procedure involved covering them with finely powered copper oxide and heating them in small platinum crucibles under an atmosphere of carbon dioxide. At the end of the treatment he found to his astonishment that he had a collection of perfect copper insects, for the outer parts of their body-shells had been penetrated by the metal and the original horny chitin, with all its fine markings, was replaced by a layer of copper.

It is thought that this method may be of value to museums in the permanent preservation of rare and perishable insect specimens, and possibly plants as well. There is also the possibility that a vogue in natural jewelry may be based upon it.—*Science Service.*

Self-governing Wind-power Wheel

WIND wheels have been used for many years in rural sections of the United States for pumping water or for doing other small jobs about the farm. They have not been used to any great extent for the generation of electric power because of the intermittent nature of the propelling wind

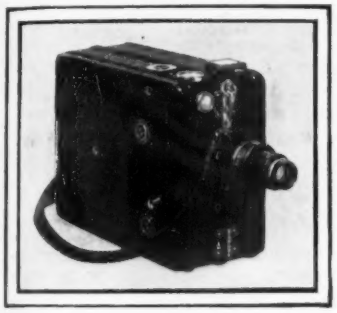
Huge wind-power wheel for generating electricity for the farm

and the difficulty of governing the wheels.

The Charles E. Miller Rubber Works of Anderson, Indiana, has developed a wheel, however, that is particularly adapted for the generation of electric power since it is self-governing and thus can be set to run at a constant speed. While the wheel is running at the pre-set speed, strong springs hold the four blades, each weighing about 75 pounds, in tension against the hub, their wind surfaces being held at the normal angle for running. A tendency to excessive speed will, however, throw the blades outward as the centrifugal force overcomes the spring tension, and the blades will spiral to an angle out of the wind—the wheel changes from a power wheel to a fan. When the speed decreases, the centrifugal force is lessened, the springs exert their pull again, and the blades are drawn back into the normal running angle.

The complete apparatus consists of wheel, tower, and electric generator. The wheel can be set to run at, say 100 revolutions per minute, and it will not exceed that re-

William Beebe Used a DeVry



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gardless of the wind rate. It is claimed that it will generate electricity in a wind that has a speed of as low as four miles per hour.

The wheel shown in the accompanying illustration is 15 feet in diameter, and the tower is 75 feet high. The manufacturers state that this wheel will generate enough electricity for three ordinary farm residences.

A Smallpox "Scapegoat"

THE ancient Hebrew custom of loading the sins of the people on a scape-goat, which bore them off into the wilderness, has a modern parallel in a certain district in central India. It is not sins, however, which the modern scape-goat is required to carry off, but smallpox.

When an outbreak of smallpox occurs in a village, the inhabitants resort to the ceremony of "Nieasi." A female goat is purchased by public subscription, and is adorned with the particular types of ornament usually affixed to the image of a goddess. The goat is then apparently looked upon as an incarnation of the goddess of the disease. The animal is supposed to remove the epidemic as she is passed on from village to village until she reaches her own temple, or is devoured by wild beasts on the way.—*Science Service.*

"Fatherless" Apples Have Fertile Seeds

HEALTHY apple trees grown from seed that never had a father have been produced in Switzerland, according to Dr. Charles F. Swingle, National Research Council Fellow in Botany, who is now studying at the University of Leeds, England. The production of seed by unpollenated flowers is not unknown in the plant world, for the common dandelion regularly forms asexual seed and many other plants do likewise; but it has long been almost a dogma that viable apple seeds could not be formed without the intervention of the male element which comes from the pollen. The Swiss trees, according to Dr. Swingle, have been grown from seeds produced by flowers which had been deprived of their stamens and covered with bags to prevent insects from bringing in pollen from other flowers. Their fruits are identical with those of their mother trees, which rarely is the case in ordinary seedling apples but regularly occurs with asexually propagated, that is, grafted, trees.—*Science Service.*

Ultrafine Wire

FOR scientific purposes, wires of extraordinary fineness are now produced by either the Wollaston or Taylor methods, says the industrial bulletin of Arthur D. Little, Inc. By the former a length of bare drawn wire is inserted into a tube of another metal. The composite rod is then die-drawn to the required fineness, after which the far finer core of the desired metal is obtained by dissolving away the metal of the jacket. It is thus possible to produce gold wire 0.00001 inch in diameter, or 1/50th that of the finest drawn wire.

In the Taylor method, as applied to materials lacking in ductility, the metal is melted in a glass or quartz tube and the tube and its contents then drawn down.

By way of comparison, it may be mentioned that the diameter of human hair varies between 0.006 and 0.0126 inch.

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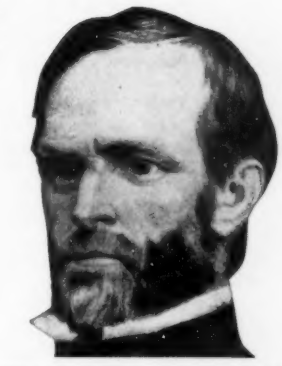

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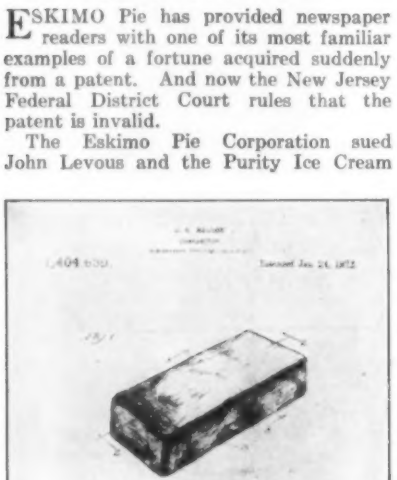
Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Eskimo Pies Are Old

ESKIMO Pie has provided newspaper readers with one of its most familiar examples of a fortune acquired suddenly from a patent. And now the New Jersey Federal District Court rules that the patent is invalid.

The Eskimo Pie Corporation sued John Levous and the Purity Ice Cream Company for infringement of the Nelson patent for a chocolate-covered block of ice cream. The extent of the business may be judged from the fact that there are 1960 licensees. In 1926, 181,000,000 "pies" were sold; for the first 10 months of 1927, 210,000,000 pies were produced. The sole issue in the case was validity.



In two states the courts hold there is no invention in Eskimo Pie

"All that the patentee does," says Judge Bodine, "is to take a small brick of ice cream and coat it with chocolate just as candies are coated. Val Miller took a round ball of ice cream and coated it just as candies are coated. In one case the ice cream is round in form and in the other case it is rectangular. In both cases there is a sustaining and self-retaining casing sealing the core of ice cream.

"The Cann Ball ice cream was, a few years ago, popularized as the Babe Ruth Baseballs and sold quite as well as Eskimo Pie. The Babe Ruth Baseballs are said to have been eaten by hand just as the Pie is eaten.

"In view of the disclosure, there was nothing novel in coating a bar of ice cream with chocolate. Even the sustaining and self-retaining casing of chocolate covering a liquid was not novel. Tobien shows that the chocolate he used was designed as a covering for the contents when liquid. He does not limit his disclosure to candy or brandy filling.

"Nelson did cover his 'Pie' with tin foil, but he does not claim any invention in this. And he certainly could not, in view of the fact that yeast, confections and other edibles have been so covered for years. There was neither a new creation of elements by Nelson, nor a new resultant. Val Miller and Tobien had the same elements and the same resultant. There is no invention in form alone.

"Commercial success is not conclusive upon the question of invention. It merely shows here that the alleged patentee anticipated a desire for ice cream."

Saved By a Crow

THE Stix, Baer and Fuller Company recently sought to register the notation "Royston" as a trademark for men's and boys' apparel. The Patent Office Examiner denied registration on the ground that the word is geographical in its significance, being the names of two towns in England and a town in Franklin County, Georgia, and being also a surname. On appeal First Assistant Commissioner Kinnan revised the decision, saying:

"The New Standard Dictionary, 1926 edition, states that the notation here sought to be registered is also used to indicate the gray or hooded crow known in England and called the Royston crow. It would seem, in consequence, that the notation is used in other senses than those referred to by the examiner. In view of these facts, it is believed the average member of the public would regard the mark as fanciful, and that it should be registered."

What Is a Havana Cigar?

THE Federal Trade Commission has ordered Bayuk Cigars, Incorporated, of Philadelphia, to discontinue the use of the word "Mapacuba" as a brand name of cigars not composed either in whole or in part of tobacco grown on the island of Cuba. When the name is used as a label for cigars made only in part from tobacco grown in Cuba, then the word must be followed by letters equal or greater in size, visibility and conspicuousness, clearly indicating that such cigars are made only partly from Cuban tobacco. With its order the Commission has issued a statement summarizing the Cuban cigar industry. It says:

"Cuba has the distinction of being the first place where the smoking of cigars was discovered by civilized man. Columbus discovered that the natives of the island were smoking the tobacco and he took some back to Europe. The Spaniards quickly recognized the commercial value of the weed and immediately began its cultivation and manufacture into cigars in Havana, Cuba.

"The excellence of the Havana or Cuban tobacco was such that the trade grew so rapidly that the manufacturers, who were all at that time located in Havana, Cuba, were unable to keep up with the demand. Havana became the cigar manufacturing center of the world and the tobacco and cigars were marketed under the name Havana.

"Cuban tobacco, because of its distinctive aroma and mildness, has always been considered the finest tobacco in the world for cigars, and cigars made from such tobacco have the reputation among the consumers and the trade as being the finest produced. This reputation has existed for more than 300 years and has never been equalled or excelled by any other tobacco."

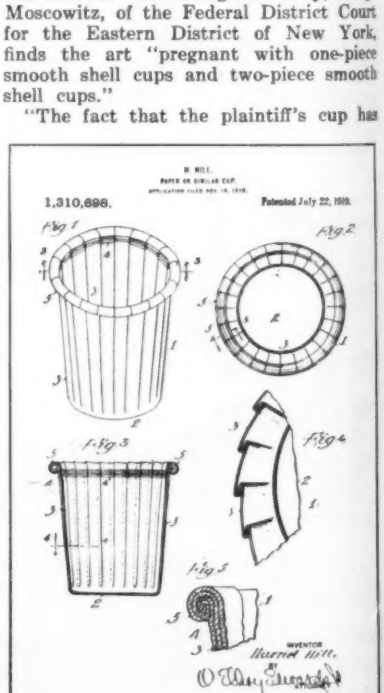
The Tulip Cup Patent Invalidated

UNDER a patent issued in 1919, containing a single claim, the Tulip Cup Corporation has been doing a nation-wide business in individual paper drinking cups. This claim reads as follows:

"A substantially circular paper cup made from a single blank having a bottom, plaited sides with overlapping portions, and a curled rim substantially circular in cross section for stiffening the same."

Recently suit for infringement was brought by the Tulip Corporation and the United States Machine Manufacturing Company against the Ideal Cup Corporation. The defense was that the patent was invalid. In finding invalidity, Judge Moscowitz, of the Federal District Court for the Eastern District of New York, finds the art "pregnant with one-piece smooth shell cups and two-piece smooth shell cups."

"The fact that the plaintiff's cup has



Despite the success of the Tulip cup, its patents disclosed nothing new which justified a monopoly

been commercially successful is not in itself sufficient to show that it is a patentable invention," he says. "Commercial success is an unsafe guide to invention unless prior efforts to fill the space be shown; and when it is shown it is not infrequently found that the faculty of invention was not necessary to fill whatever vacancy existed.

"Where one uses merely the expected skill of the calling, and involves only the exercise of the ordinary faculties of reasoning upon the materials supplied by a special knowledge, and the facility of manipulation which results from its habitual and intelligent practice, he has in no sense achieved the creative work of that inventive faculty which it is the purpose of the Constitution and the patent laws to encourage and reward."

No Trademarks For Service

GREGG AND SONS, Incorporated, repair, clean, renovate and dye fabrics and furs. Upon each garment they handle they place a label. Recently they sought to register this label as a trademark. The Commissioner of Patents refused to register the mark, whereupon they appealed to the Court of Appeals of the District of Columbia. The Commissioner was upheld.

"To entitle an applicant to the registration of a trademark it must appear that the mark has been used on an article of commerce, and that it has been used in commerce," says Justice Van Orsdell. "The mark must likewise possess a distinctive identifying characteristic of the article to which it is affixed and must be used to indicate the origin of ownership of the article to which it is attached.

"Appellant company does not rise to the dignity of a dealer or retailer who may have his mark placed upon the goods he handles by the manufacturer, for in such cases the dealer or retailer is the owner of the goods, and as such comes clearly within the registration requirements. Neither is appellant a producer of the goods, since he possesses neither origination nor ownership."

The Checker Taxi Case

IN 1923 a man named Connolly was operating, on the streets of Cleveland as a taxicab, a second-hand Hudson sedan. Around the top of the tonneau he pasted a border of paper in contrasting colors to give a checker board effect. The city of Cleveland seemed to be a good place in which to operate taxicabs, so the Checker Cab Manufacturing Corporation introduced one of its well-known checker taxicabs. Then it sold this one cab and 49 new ones to a new company, the Green Cab Company, organized by Waite and Lester. The new operators painted their cabs green but added the checker border with the full approval of the Checker company.

Connolly sued the Green Company to restrain their use of the checker border which he had used first. The suit was settled out of court and Connolly turned over his one cab, together with any trademark rights he might have had, to the Green Company. The Checker Corporation footed the bill.

Last year the Green Company bought 52 additional taxicabs, but it did not buy them from the Checker Company. Upon these cabs, also, it placed a checkered border, whereupon the Checker Corporation sought an injunction in the Federal District Court for Northern Ohio restraining the use of the checker border upon the new cabs.

It was an interesting question. The Checker Corporation had acquired the checker design from the taxi chauffeurs in Chicago who originated it and had sold enough in interstate trade to establish it as a manufacturer's trademark. They applied for registration of the trademark in the Patent Office.

"Plaintiff's contention is that defendant may not acquire other and additional taxicabs elsewhere and use the same in its taxicab fleet with the checker border," Judge Westenhaver holds. "I agree that these rights must be conceded to defendant. The written agreements did not require defendant to remove the checker border from cabs previously acquired, either when these agreements expired or when defendant should cease to buy and use exclusively plaintiff's taxicabs.

"If defendant may rightfully use the checker border upon 200 taxicabs, why may it not use the same upon other taxicabs? If it may not use the checker border upon other taxicabs, it is compelled to produce confusion in the public mind with respect to its own business and service. The demoralizing effect upon defendant's business of being compelled to use one, 10 or 50 taxicabs marked one way, and 200 marked another way, can be readily foreseen.

"Here the defendant did not directly agree to operate its taxicabs with the checker border as a trademark. It did not agree that the checker border, if placed on defendant's fleet of taxicabs, should remain the property of the manufacturer in that new business. It did not agree that when the exclusive agreements to buy and use plaintiff's cabs were ended it would remove the checker border from its fleet. Plaintiff, in order to obtain a local market, as well as to advertise its product elsewhere, induced defendant to place the checker border on the taxicabs operated by defendant in its business. Plaintiff did so in such a way and under such circumstances as would demoralize defendant's trade if in the future that right were withdrawn. It must be held, I think, that plaintiff acquiesced in the adoption and use by defendant as an identifying trade-mark of its local service, of the checker border, and, after having done so, it is not now in a position in equity to compel a discontinuance of that use.

"It follows that as a result of these views, the preliminary injunction heretofore awarded, should be dissolved and that plaintiff's bill be dismissed at its costs."

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Pertaining to Apparel

GARMENT—Having a self-adjusting elastic tape securely anchored at its ends in a tubular waistband, yet readily removable when it is desired to launder the garment. Patent 1661922. S. S. Chesnin, 1182 Broadway, New York, N. Y.

VENTILATING FOOT COVERING—Operable by the usual motion of the foot in walking to set up a constant circulation of air into the shoe and around the foot. Patent 1660698. O. P. Williams, 8603 Grandview Ave., Southgate, Calif.

SWEATER—Of the sport coat type, so reinforced with knitted fabric as to limit the transverse stretching of the garment, and the sagging adjacent the shoulders. Patent 1662731. J. Zimmerman, c/o Paramount Knitting Mills, 22 St. and Lehigh Ave., Philadelphia, Pa.

SUPPLEMENTAL OUTSOLE FOR SHOES—Which is to prevent the entrance of dampness and protect the regular out-sole against wear thereby increasing the length of life of the shoe. Patent 1662756. B. Montante, Pra Ave., Libertad 8, San Louis Potosi, Mexico.

Designs

DESIGN FOR A STOCKING—Patent 74680. R. Lefi, c/o Lefi & Co., 389 5th Ave., New York, N. Y.

DESIGN FOR A PICTURE-MACHINE CASING—Patent 74698. W. Rabkin, 627 W. 43rd St., New York, N. Y.

DESIGN FOR A BOOK END OR SIMILAR ARTICLE—Patent 74707. T. S. Woodward, Leetonia, Ohio.

Electrical Devices

FEED-WIRE SUPPORT—By means of which it will not be necessary to unscrew the hanger from the insulator stud to remove the feed wire. Patent 1661902. N. A. Michaelson, Collier Mine, R.D. No. 3, Uniontown, Pa.

SIGNALING SYSTEM—Particularly adapted for use with standard printing telegraph apparatus at present in use, and for wireless signaling in conjunction therewith at a higher speed. Patent 1661962. N. A. Robinson, 548 Riverside Drive, New York, N. Y.

RADIO APPARATUS—Which provides a tuning circuit split in two branches having fixed unequal inductances for producing opposing magnetic fields, variable capacities, and a common control. Patent 1660108. N. J. Vignolo, 1016 Santa Clara Ave., Alameda, Cal.

LINE BREAKER—Which may be mounted upon the cross arms of electric light or telephone poles, so that loop ends may be anchored without danger of accidental contact. Patent 1663421. E. L. Stubbings, Box 379, Huntington, N. Y.

Of Interest to Farmers

GAUGE WHEEL FOR AGRICULTURAL IMPLEMENTS—For gauging the distance to which plows, cultivators or other tools may enter the ground and for securing the tool in its adjusted position. Patent 1661237. S. W. Shaw, Galesburg, Kans.

SILO SEAL—Which renders the pressure on the sealing cap more uniform at the edges, may be assembled within the silo and readily removed or adjusted. Patent 1663478. F. Gunther, 904 Putnam St., Peru, Ill.

SOIL IRRIGATOR—Adapted for conveying water from a relatively remote point, and operating automatically in response to the flow, to distribute the water uniformly over a large circular area. Patent 1660891. J. C. Searle, sr., 2349 London St., Los Angeles, Calif.

STOCK LOADER AND CONVEYER—For gathering, loading, transporting and unloading, bundles or sheaves of grain or analogous crops, and is especially designed for use in connection with threshing machines. Patent 1662755. W. A. McQuay, 389 Tweed Ave., Winnipeg, Canada.

EGG FACTORY—A "factory" with entire equipment for housing three thousand hens, and means for handling feed, water, heating apparatus and the shipping of eggs, under one roof. Patent 1663479. O. W. Maples, P.O. Box 137. Middletown, N. Y.

Of General Interest

WINDOW CLEANER—A simple construction, operated by hand, for both cleaning and drying a window inside and out, without leaning out of the window. Patent 1662038. F. Bodenhofer, 1228 Intervale Ave., Bronx, N. Y.

FASTENING DEVICE—Having a wide range of utility, but finding its preferred embodiment as a securing means for dust covers on automobile and other upholstery. Patent 1661911. D. I. Reiter, 142 Fifth Ave., New York, N. Y.

CIGARETTE CASE—Made up of sections which automatically move to an open position and render the contents accessible, the opening and closing being performed by one hand. Patent 1662028. M. Gold, A. F. Most and J. Fogel, c/o Gold, Most & Fogel Co., 33 W. 46th St., New York, N. Y.

COMBINED DOOR AND MIRROR SUPPORT—For bathroom cabinets, which permits of substantial universal movement and adjustment to obtain the best light on the mirror by tilting the same. Patent 1661899. D. A. Martens, 511 Kalmia Ave., Flushing, N. Y.

BRICK—Which may be easily laid with or without mortar between the contacting surfaces, which will avoid joints directly through the wall, and the transmission of moisture. Patent 1661946. H. A. W. Howcott, 320 Kernan Bldg., 317 Fla. St., Baton Rouge, La.

CUFF BUTTON—In which the co-operating parts when lightly pressed together cannot be disengaged by pulling, but when more firmly pressed will be released. Patent 1661520. G. Wullum, 1733 N. Francisco Ave., Chicago, Ill.

COLLAPSIBLE TABLE—Having a leaf housed under the table top when the latter is collapsed, and moved into position between two sections when the table is expanded. Patent 1662684. F. M. Sanders, 1753 E. 10th St., Brooklyn, N. Y.

DOLL HEAD—Having in addition to the automatic open and closed positions of the eyes, a manually controlled arrangement by which the eyes may simulate winking. Patent 1662691. J. C. White, Sewickley, Pa.

PROCESS FOR PRODUCING ASPHALT PAVING MIXTURES—Consisting of separately prepared granulated mineral compositions of high and low melting qualities, which are solidified by the action of pressure after mixture on the road bed. Patent 1662377. J. S. Downard, 2045 Douglas Blvd., Louisville, Ky.

PIER-SHED DOOR—Formed in sections, and associated with mechanism for readily elevating the same from a closed position, to a partially or completely open one. Patent 1662709. M. H. Korn, 165 Larch Ave., Bogota, N. J.

NESTING FURNITURE—Whereby three different size toy tables, with two chairs for each, may be cut from a solid rectangular block without leaving any waste pieces. Patent 1660119. A. K. Decker, 3437 Florence Court, Seattle, Wash.

FIXTURE ANCHORAGE—Which forms a firm support for bathroom or kitchen wall fixtures, and allows a smooth finish of plaster which will not crack. Patent 1662059. W. G. and T. A. Hemsworth, 1341 N. Dearborn St., Chicago, Ill.

TOWEL HOLDER—Especially adapted to take the place of towel racks in bath rooms, in which a towel or wash cloth may be held and easily withdrawn, without injury. Patent 1663107. B. White, c/o The Billboard, Chicago, Ill.

FLY-PAPER HOLDER—For maintaining the paper spread and sustained in a manner to minimize the possibilities of other objects contacting therewith. Patent 1663437. L. M. S. Brown, c/o Shagren & Son, Nahcotta, Pacific Co., Wash.

BAG LATCH—Of dual character, functioning as a snap fastener as well as effectively holding the frame section of the bag against pulling or other strains. Patent 1663383. M. Miller, 20 W. 36th St., New York, N. Y.

PROCESS FOR TREATING PIG IRON—And cooling the same by spraying the molds after the iron has been placed therein, permitting the iron to cool slowly and preventing "water crack." Patent 1663351. E. P. Ross, c/o Colonial Iron Co., Riddlesburg, Pa.

Hardware and Tools

UNIVERSAL SETTING GAUGE—Capable of ready adjustment and micrometric settings on machines such as planer tools, shaper tools, milling cutters, etc., to gauge the tool height. Patent 1661944. P. M. Heinz, 350 N. Grandview Ave., Dubuque, Iowa.

FILE HOLDER—For securing a file in working position so that the full force of the operator can be distributed to the surface with very little exertion. Patent 1659765. H. H. Canterbury, P.O. Box 11, Whittier, Calif.

Heating and Lighting

HOT-WATER HEATING SYSTEM—Which may be operated in extreme cold to aid the normal circulation and increase efficiency, as well as in milder weather to give just the desired heat. Patent 1661368. W. W. Hudson, c/o C. A. Stilphen, 503 Foster Bldg., Denver, Colo.

BLOW-BLAST GAS BURNER—In which the air mixer is so constructed as to exert a powerful control over the flame to create an intense heat, for house heating systems, etc. Patent 1661929. H. V. Deemar, 3002 No. Grand Blvd., St. Louis, Mo.

VAPOR BURNER—Characterized by a plurality of air and water jackets disposed around the vapor passage, particularly adapted for foundry furnaces, steam boilers, and the like. Patent 1660866. L. J. Dieu, 559 Commercial Ave., South San Francisco, Calif.

Machines and Mechanical Devices

MACHINE FOR FLATTENING TUBULAR MATERIALS—Such as spirally wound cable armors, by exerting uniform pressure at opposite sides, as the tubular material is moved along through dies. Patent 1661908. F. Palmer, c/o Triangle Conduit Co., Dry Harbor Road, Brooklyn, N. Y.

PORTABLE SOOT BLOWER—Which may be moved between boiler tubes directing steam against the exterior of the tube for removing soot and extraneous matter from the pipes. Patent 1661931. J. J. Dolan, c/o The Ohio Power Co., Coshocton, O.

SPRAY GUN AND MEANS FOR OPERATING THE SAME—Which has novel means for employing air under low pressure for spraying paint or other liquid, and for turning the mouth piece at different angles. Patent 1661239. E. Stephan, c/o Gast Mfg. Co., Bridgeman, Mich.

SEMI-AUTOMATIC TRIP FOR POWER SHOVELS—Wherein a constant rotating friction member is utilized and means for connecting the same to a drum for causing quick movement to the trip mechanism. Patent 1661955. G. G. Morin, 40 Florence Ave., Holyoke, Mass.

PLASTERING MACHINE—By which coats of plaster of uniform, predetermined thickness may be evenly applied to the walls or ceiling of a room. Patent 1663416. J. F. Raus, 532 E. 150 St., New York, N. Y.

RECEIPT RECORDER—A manually controlled printing apparatus for receipting bills, including means for recording the amount for which the bill is receipted and the date. Patent 1662034. C. H. Richter, 121 E. Main St., Trinidad, Colo.

LEVELING DEVICE—Which constitutes a self-leveling and locking means, and insures the positioning of transits, or similar instruments on a level parallel to the true horizon. Patent 1661993. C. J. Borda, c/o Columbian Govt. Bureau of Importation, 1440 Broadway, New York, N. Y.

VEGETABLE CUTTER—Capable of easy and fine adjustment to regulate the thickness of the cut or slice, performs the work quickly without crushing the vegetables. Patent 1662036. A. Stoltenberg, 342 Fifth Ave., Astoria, N. Y.

METHOD AND MEANS FOR CONTINUOUSLY VULCANIZING RUBBER STOCK—For vulcanizing continuous lengths of stock as it comes from the extruding machine, hose building machine, or other preliminary forming machine. Patent 1661888. G. F. Fisher, 12 Merry Mount Ave., Wolfston, Mass.

CUTTING AND MEASURING DEVICE FOR PAPER ROLLERS—Which permits the paper to be accurately measured, and cut at the desired point, and at the same time prevents soiling the unused paper. Patent 1662364. W. Cohen, 2665 Bedford Ave., Brooklyn, N. Y.

HOOK BAR FOR FOOTING MACHINE—Wherein clamping means grip the sheer part of the stocking to maintain the same under tension without danger of tearing or distorting the loops. Patent 1662678. N. Judson, c/o Mock & Judson, Inc., 212 5th Ave., New York, N. Y.

SCREEN FOR COTTON CLEANERS—So constructed as to be capable of use with various types of cotton cleaners, but primarily intended for cleaners of picked cotton before ginning. Patent 1662745. W. B. House, Wellington, Texas.

ATTACHMENT FOR HOISTING SLINGS—Which is secured to the loop of the cable and functions to insure the centering of the lift, and the lifting at a desired angle. Patent 1662713. L. R. Miller, 9228 222 St., Queens Village, L. I., N. Y.

COMBINED MOTION-PICTURE CAMERA AND PROJECTOR—Which may be used for taking or projecting standard pictures or a plurality of pictures on the same space that is normally occupied by one. Patent 1662057. A. K. Hadley, 994 18th St., Milwaukee, Wis.

Railways and Their Accessories

AIR BRAKE—An attachment for automatic air brake valves, which can be operated by the engineer to enable a sanding of the rails previous to application of brakes. Patent 1661947. W. R. Howdon, 222 E. 10th St., Anniston, Ala.

Pertaining to Recreation

GAME APPARATUS—Collapsible when not in use, but when open intended for playing an indoor game of marbles, much in the manner of the outdoor game. Patent 1661885. S. E. Edwards, 501 Patterson St., Algiers, La.

Pertaining to Vehicles

TENT ATTACHMENT FOR VEHICLES—A collapsible frame associated with the top of the vehicle, which can be quickly converted into an enclosure for camping, or privacy. Patent 1659825. G. MacKay, 850 North Edinburg St., Los Angeles, Calif.

TIRE HEATER—For heating metal rims of wagon wheels so that they may be expanded to a predetermined degree for application to the felloes of the wheels. Patent 1661984. W. Wiley, 509 35 St., Galveston, Tex.

GOVERNOR AND WATER CIRCULATOR—Which provides means whereby a Ford motor may be converted into a serviceable power plant for either portable or stationary work. Patent 1661903. M. J. Mohler, Wyoming, Del.

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Lack of space makes it impossible to give many cross-references or to enter a given reference in more than one place. Each article is therefore entered where it is believed it will be most easily found. In every case, the general subject should be sought rather than the supposed specific title of an article. We call special attention to the classifications "Aviation," "Radio," etc., under which many items will be found whose location otherwise would be very puzzling. The asterisk (*) indicates that the article in question is illustrated.

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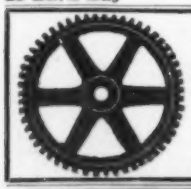

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